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HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM

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U.S. AIR FORCE
INSTALLATION RESTORATION PROGRAM
PHASE I: RECORDS SEARCH

U.S. COAST GUARD FACILITIES AT MASSACHUSETTS MILITARY RESERVATION, MASSACHUSETTS

FINAL REPORT: TASK 7

DECEMBER 11, 1986

Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831
operated by
Martin Marietta Energy Systems, Inc.
for the
U.S. DEPARTMENT OF ENERGY

106

INSTALLATION RESTORATION PROGRAM

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Prepared by the

OAK RIDGE NATIONAL LABORATORY
OAK RIDGE, TENNESSEE 37831

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MARTIN MARIETTA ENERGY SYSTEMS, INC.

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U.S. DEPARTMENT OF ENERGY
Under Contract No. DE-AC05-84OR21400

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EXECUTIVE SUMMARY

INTRODUCTION

The Department of Defense (DOD) has developed a program to identify and evaluate past hazardous material disposal sites on DOD property, to control the migration of hazardous contaminants, and to control hazards to health or welfare that may result from these past disposal operations. This program is known as the Installation Restoration Program (IRP) and consists of four phases: Phase I--Initial Assessment/Records Search; Phase II--Confirmation and Quantification; Phase III--Technology Base Development; and Phase IV--Operations/Remedial Actions. The National Guard Bureau (NGB), under the auspices of the Air National Guard (ANG), enlisted the services of and provided funding to the Oak Ridge National Laboratory (ORNL) for the purpose of conducting the Massachusetts Military Reservation (MMR) IRP. E.C. Jordan Co. (Jordan), ORNL's Region I contractor, was tasked with this responsibility. As part of this tasking, Jordan conducted a Phase I Study of the U.S. Coast Guard (USCG) at the MMR.

INSTALLATION DESCRIPTION

The MMR is located on the upper or western portion of Cape Cod in Barnstable County, Massachusetts, approximately 60 miles south of Boston and immediately southeast of the Cape Cod Canal. The towns of Bourne, Falmouth, Sandwich, and Mashpee intersect on MMR property.

MMR occupies approximately 20,000 acres and consists of several cooperating command units. These are the Massachusetts Army National Guard, Massachusetts ANG, the United States Air Force (USAF), the Veterans Administration, and USCG.

The USCG facilities at MMR consist of 1,407 acres broken into four separate areas. These are the housing and support area, Hangar 128, Hangar 3170, and the Radar Station (RADSTA) Boston Remote Transmitter Site. Within the housing and support area are located Facilities Engineering, the Chapel, the medical dispensary, golf course, base commissary and exchange facilities, and four separate housing zones. The Hangar 128 area, located among the Otis-ANG Facilities, provides a hangar and maintenance facility for USCG fixed-wing aircraft. The Hangar 3170 Area houses USCG Rotary-Wing Aircraft operations. The RADSTA Transmitter is located in the range area of MMR and serves the communication surveillance activities of the First Coast Guard District.

Located within the USCG housing area are three public schools and one private school. These are served by base water supply and support. The three public schools, Stone School, Otis Memorial School, and Lyle School, are operated by the Town of Bourne. Falmouth Academy is operated by a private concern.

The USCG and USAF completed negotiations in 1964 to relocate Air Station, Salem, Massachusetts, to MMR. Full operations at Coast Guard Air Station Cape Cod began in 1970. Overall base management was under USAF control until 1973

when the base was transferred to the Massachusetts ANG under management of the 102nd Fighter Interceptor Wing.

The primary mission of the Air Station is air and sea search and rescue. Search and rescue responsibility encompasses the area from Rhode Island to the Canadian border. An average of 400 rescue cases per year are handled. Secondarily, the USCG mission includes: federal law and treaty enforcement on the high seas and territorial waters of the United States, enforcement of safety regulations on the high seas and territorial waters of the United States, surveillance for protecting the marine environment, and maintenance of housing and support facilities to carry out the primary and secondary operational missions.

ENVIRONMENTAL SETTING

The following paragraphs summarize the environmental characteristics of MMR relevant to contaminant migration. The MMR is situated on upper Cape Cod in the Coastal Plain province. The USCG facilities lie on a broad, flat, gently sloping outwash plain. The range, impact, and maneuver area and the areas on the western portion of the MMR lie mainly on hummocky, morainal terrain. Throughout the MMR, numerous kettle holes dot the landscape. The reservation contains two named ponds (Osborne Pond and Edmunds Pond) and several other small water bodies. Surface water runoff is virtually nonexistent due to the high permeability of the soils and the relatively flat topography. In the southern portion of MMR, however, intermittent streams or drainage swales exist. Flow may be initiated in the drainways during periods of heavy rainfall as a result of discharge from the storm sewer system that drains the flightline area. The intermittent stream courses lead off-base toward Ashumet Pond and Johns Pond.

Soils on the MMR consist of a mixture of sandy to sandy-loam surface soil and subsoil with a substratum of sand and gravel. In the moraine areas many large boulders are present. The soils are highly permeable and would be susceptible to infiltration by contaminants.

A federally designated sole source aquifer exists under unconfined conditions beneath the MMR. This aquifer occurs in the unconsolidated sand and gravel deposits. This sole source aquifer supplies the Upper Cape. By virtue of its location on the highest elevation of this system, MMR represents a major recharge area. Groundwater flows radially from MMR. The predominant flow direction from the USCG facilities in the built-up area of MMR facilities known as the cantonment area is to the south. Flow direction from the transmitter site is to the east. The water table averages generally 50 ft below the surface on base. Recharge to the aquifer is from precipitation and from inflow from adjacent zones of the aquifer. Discharge is to lakes and ponds, rivers, and the ocean, in addition to utilization as potable water supply.

Groundwater quality at MMR has been closely monitored. Several wells, including potable supply wells, show detectable concentrations of volatile organic priority pollutant compounds (VOCs), predominantly the solvents tetrachloroethylene (PCE) and trichloroethylene (TCE). Trihalomethanes were also detected

but in much lower concentrations on the reservation. In addition to VOCs, oil and grease and other petroleum-related hydrocarbons were detected in several monitoring wells. Overall, significant contamination of the groundwater beneath MMR has been detected. Because of the groundwater flow rate of 1 to 2 ft/d, there is potential for contamination to migrate off-base. Organic compounds have been identified to the south of MMR. The extent and sources of the on- and off-base groundwater contamination is currently under study as components of the overall MMR IRP.

Water quality in Ashumet Pond, which is downstream and downgradient of the reservation, shows a trend toward eutrophication, which results from impact of excess nitrogen and phosphorus. In addition, toluene and TCE have been detected in the waters of a cranberry bog located immediately north of Ashumet Pond.

Average annual rainfall at MMR is approximately 48 in., and net precipitation (total rainfall minus evaporation and other losses) is 21 in. The 1-yr, 24-hr rainfall event is 2.7 in. The value of 21 in./yr for net precipitation indicates a significant potential for infiltration as well as surface runoff and the occurrence of permanent surface water features. The 1-yr, 24-hr rainfall event of 2.7 in. indicates a significant potential for runoff and erosion. These data indicate that contamination at MMR could migrate significantly by both surface water and groundwater pathways. The high permeability of the soils and the low topographic gradient greatly reduce potential for surface water contamination migration.

Twenty percent of MMR consists of developed land, whereas the remaining 80% remains undeveloped and provides natural habitat for wildlife. Forests on MMR exist in the undeveloped areas and are classified as pine oak climax forests. The two larger ponds support populations of warm water species of fish. Wildlife management at MMR consists of a deer hunting season admin-istered by the Massachusetts Division of Fisheries and Wildlife.

There are currently no known Federal endangered or threatened wildlife species occurring on MMR. There are three species of birds that are classified as either State Endangered, State Threatened, or Species of Special Concern by the Massachusetts Division of Fisheries and Wildlife. These are the upland sandpiper, the marsh hawk, and the grasshopper sparrow. There are also two areas on MMR that support rare plants.

As a result of the hydrogeological environment and soil characteristics, conditions at MMR are conducive for contaminant migration. Contaminants would primarily migrate vertically through the soils to the groundwater. Contaminant transport by surface water would be very limited due to the surficial permeability. Contaminants entering the groundwater could potentially contaminate the sole source aquifer used as potable water by residents of Cape Cod.

METHODOLOGY

During the course of the Phase I investigation of the USCG facilities, interviews were conducted with base personnel (past and current) familiar with past waste disposal practices; file searches were performed for past hazardous waste

activities; interviews were held with local, state, and federal agencies; and ground reconnaissance inspections were conducted at past hazardous waste activity sites.

Twelve sites were identified as potentially containing hazardous contaminants resulting from past activities. Seven of these sites have been assessed using the USAF Hazard Assessment Rating Methodology (HARM), in which factors such as site characteristics, waste characteristics, potential for contaminant migration, and waste management practices are considered. The details of the rating procedure are presented in Appendix G. The hazard assessment system is designed to indicate the relative need for follow-up action (Phase II).

FINDINGS AND CONCLUSIONS

The goal of the IRP Phase I study is to identify sites where there is a potential for environmental contamination resulting from past waste disposal practices and to assess the potential for contaminant migration from these sites.

Twelve sites were identified as having potential for environmental contamination. These sites, dates of operation or occurrence, and evaluations of these sites are summarized in Table E-1. Site locations are shown in Figure E-1 and E-2. The relative potential of the sites for environmental contamination and contaminant migration was assessed, and Phase II Stage 1 monitoring recommendations were made for Sites CS-1, CS-2, CS-3, CS-4 and CS-6.

The intent of the HARM system is to identify potential for contamination. It is expected that not all sites ranked and selected for Phase II study will show contamination during the verification program. As applied to the Phase I studies at MMR, the HARM constitutes an extremely conservative approach to site evaluation. This is because of three environmental factors specific to MMR. First, MMR is a major recharge area for a designated sole source aquifer. As a result the receptor's subscores for all sites are high compared to most installations. Second, the unconsolidated surface substrate is extremely permeable. Minimal surface water transport occurs, but groundwater movement is rapid. The pathways subscore is, therefore, also relatively high, although the severity of this score is mitigated due to the presence of a thick vadose zone (approximately 50 ft in the cantonment area). Third, the HARM lists petroleum-related aliphatic and aromatic hydrocarbons as persistent. The length of time that these compounds as well as halogenated solvents persist after a spill or disposal may be much shorter at MMR than most areas because the soils are very low in organic content and may not retard migration. Under these environmental conditions the HARM may overrate the chemical characteristics subscore by overrating persistence. The low soil organic content and probable low levels of nitrogen and phosphorus, however, would tend to reduce the capacity or rate for microbiological degradation or transformation.

Because of these environmental conditions some sites at MMR may receive high ranking scores when residual contamination is no longer present. This is especially likely where the disposal or spill occurred relatively long ago. Contaminants at such sites may have migrated into the groundwater or deep into the vadose zone. Generalized groundwater contamination at MMR may exist as a

TABLE E-1

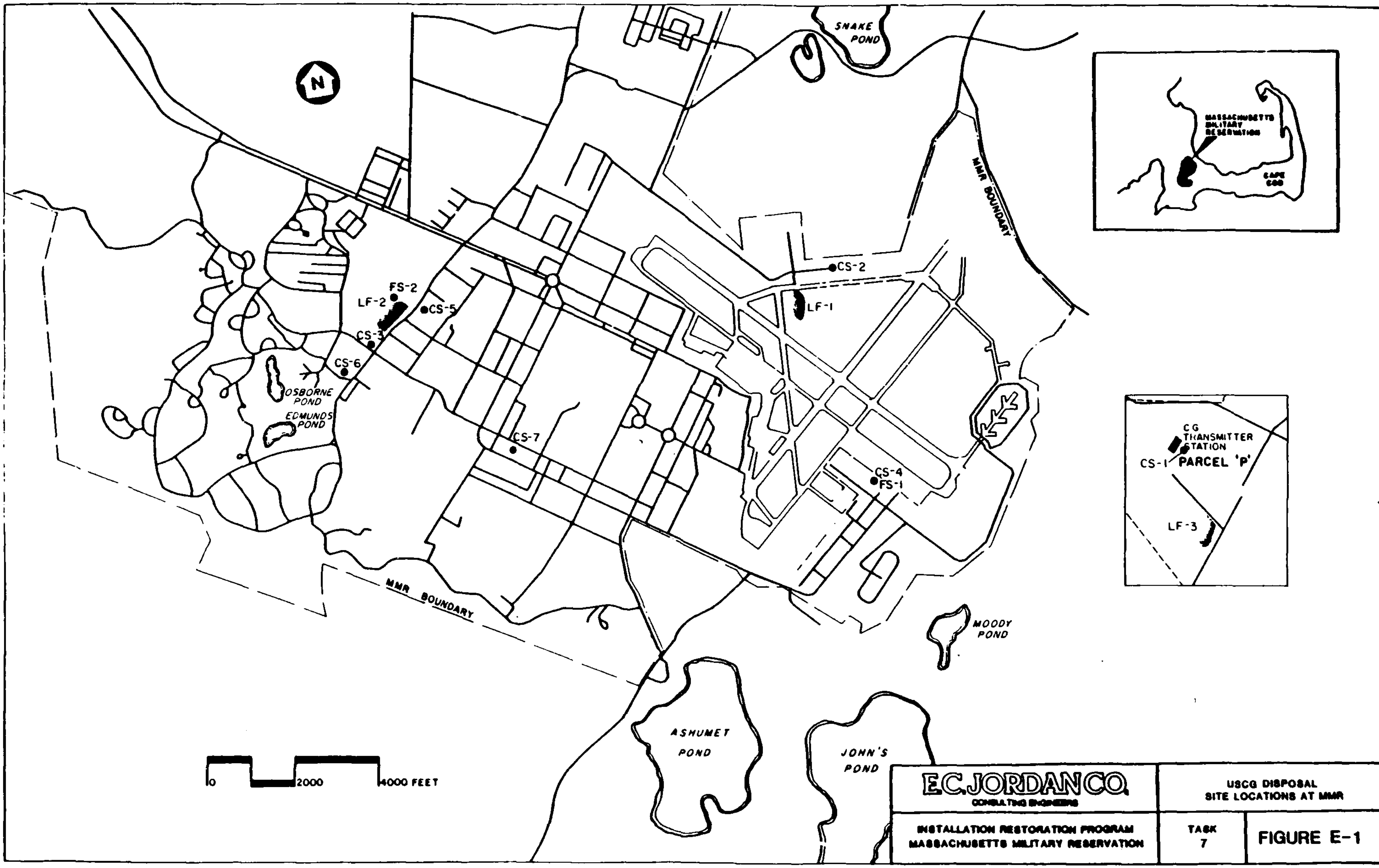
SUMMARY OF POTENTIAL CONTAMINATION AT USCG FACILITIES
ON MMR

Report Designation	Site Description and Location Figure	Date of Operation or Occurrence	Conclusions
LF-1	Rubble/Debris Landfill No. 1	1950s	Concrete and asphalt debris from runway extension. No potential for contamination. No recommended Phase II activities.
LF-2	Rubble/Debris Landfill No. 2	Unknown	Concrete rubble disposed into low area. No evidence of contamination. No HARM rating. No recommended Phase II activities.
LF-3	Rubble/Debris Landfill No. 3	1985-Present	Rubble/debris landfill currently receiving inert wastes from dispensary construction. No potential for contamination. No HARM rating. No recommended Phase II activities.
CS-1	USCG Transmitter Site	1969-1975 USCG 1961-1969 USAF	Waste POL and solvents disposed onto ground. Possible buried capacitors, transformers, and transformer oil. Received a HARM rating. Phase II studies recommended.
CS-2	Hangar 3170 Areas	1970-1985	Disposal on the ground. Waste POL and solvents battery electrolytes. Received a HARM rating. Phase II studies recommended.
CS-3	BX Automobile Service Station	USCG 1970-1985 USAF 1955-1970 (Aircraft Maintenance)	Waste POL leaking underground tanks. Visible contamination removed. Received a HARM rating. Limited Phase II studies recommended.
CS-4	Hangar 128 Area	USCG 1976-Present USAF 1955-1970 (Aircraft Maintenance)	Waste POL and solvents spilled on ground and onto hangar deck that has open floor joints. Received a HARM rating. Limited Phase II studies recommended.
CS-5	Carpentry Shop	1973-Present	Spills of turpentine and latex paint. No potential for residual contamination. No HARM rating. No recommended Phase II activities.
CS-6	Other USCG Maintenance Shops	1973-Present	Spill of waste POL and solvents. Received a HARM rating. Limited Phase II studies recommended.

TABLE E-1 (continued)

SUMMARY OF POTENTIAL CONTAMINATION AT USCG FACILITIES ON MMR

Report Designation	Site Description and Location Figure	Date of Operation or Occurrence	Conclusions
CS-7	Dry Cleaning Facility	1960s to 1975	Possible spills and disposal of PCE into the sanitary sewer. Contaminant migration is via the sewer system areas to the MMR Sewage Treatment Plant. No HARM rating. No Phase II studies recommended. Phase II studies for the MMR Sewage Treatment Plant were recommended as a component of the Task 6 Phase I report.
FS-1	Hangar 128 Fuel Spills	1978	AVGAS spills. One 1,000 gal. spill washed to storm sewer. Storm drainage at MMR is evaluated in a separate Phase I report. One 200-300 gal. spill washed onto ground. No potential for contaminant migration. No HARM rating. No Phase II studies recommended.
FS-2	Hot-Mix Asphalt Plant	1941-1943	Estimated 8,000 gal. kerosene used to clean equipment. Disposed of to land surface. Received a HARM rating. Because of the long period of time since the disposal occurred, Phase II studies are recommended only if residual hydrocarbons are found in more recent (1950's-1960's) disposals of JP-4 AVGAS and MOGAS.



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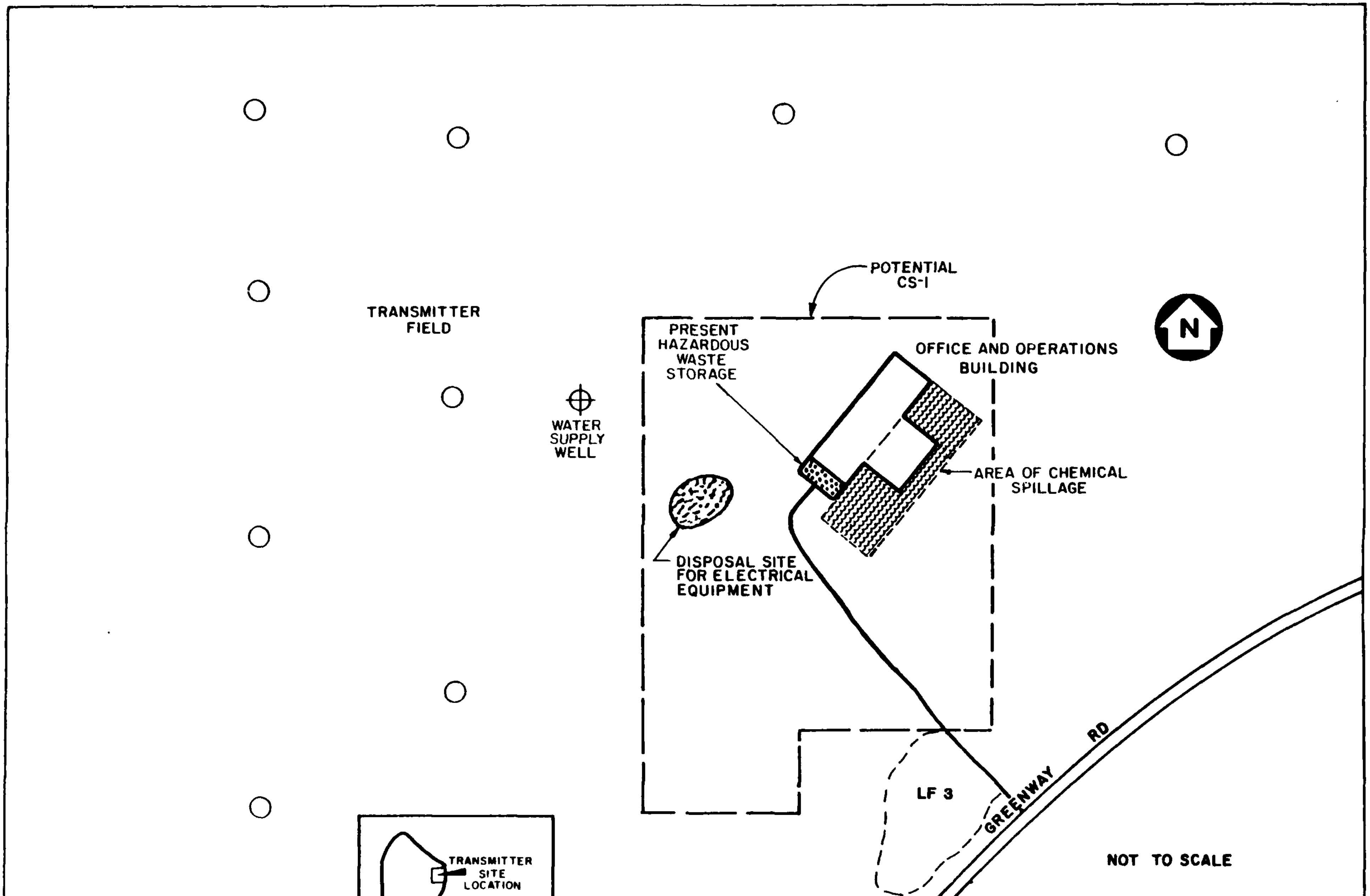
INSTALLATION RESTORATION PROGRAM
MASSACHUSETTS MILITARY RESERVATION

USCG DISPOSAL SITE LOCATIONS AT MMR

TASK 7

FIGURE E-1



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MASSACHUSETTS MILITARY RESERVATION

USCG TRANSMITTER FACILITY
DISPOSAL SITES

TASK 7

FIGURE E-2

result of contaminants that have migrated from sources that no longer actively contribute to contamination of the groundwater. However, in the absence of site-specific environmental data regarding persistence of sources and transport and fate of contaminants the conservative approach taken in this assessment is warranted. The factors that tend to minimize the persistence of contaminants frequently promote migration. Because of these factors, it would be premature to discount any potential for residual contamination, particularly because of the sole source nature of the aquifer.

RECOMMENDATIONS

Recommended actions are intended to be used as a guide in the development and implementation of the Phase II study. Rationale for recommendations to proceed with Phase II Stage I assessment of Sites CS-1, CS-2, CS-3, CS-4 and CS-6 are presented in Section 6.0. Phase II as well as Phase IV-A studies are ongoing at MMR as components of the overall IRP. Recommendations for Phase II studies at the USCG sites consider data being gathered within these programs.

1.0 INTRODUCTION

1.1 BACKGROUND

The U.S. Air Force (USAF), due to its primary mission in the defense of the United States, has long been engaged in operations dealing with toxic and hazardous materials. Federal, state, and local governments have developed strict regulations requiring disposers of hazardous wastes to identify the locations and contents of disposal sites and take action to minimize the hazards in an environmentally responsible manner. The primary federal legislation governing disposal of hazardous waste is the Resource Conservation and Recovery Act (RCRA) of 1976, as amended. Under Sec. 6003 of RCRA, federal agencies are directed to assist the U.S. Environmental Protection Agency (EPA), and under Sec. 3012, state agencies are required to inventory past disposal sites and make the information available to the requesting agencies. To ensure compliance with these hazardous waste regulations, the Department of Defense (DOD) developed the Installation Restoration Program (IRP). The current DOD IRP policy is contained in Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5, dated Dec. 11, 1981, and implemented by USAF message dated Jan. 21, 1982. DEQPPM 81-5 reissued and amplified all previous directives and memoranda on the IRP. DOD policy is to identify and fully evaluate suspected problems associated with past waste disposal practices and to control hazards to health and welfare that resulted from these past operations. The IRP will be the basis for response actions on USAF installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as clarified by Executive Order 12316. CERCLA is the primary federal legislation governing remedial action at the past hazardous waste disposal sites.

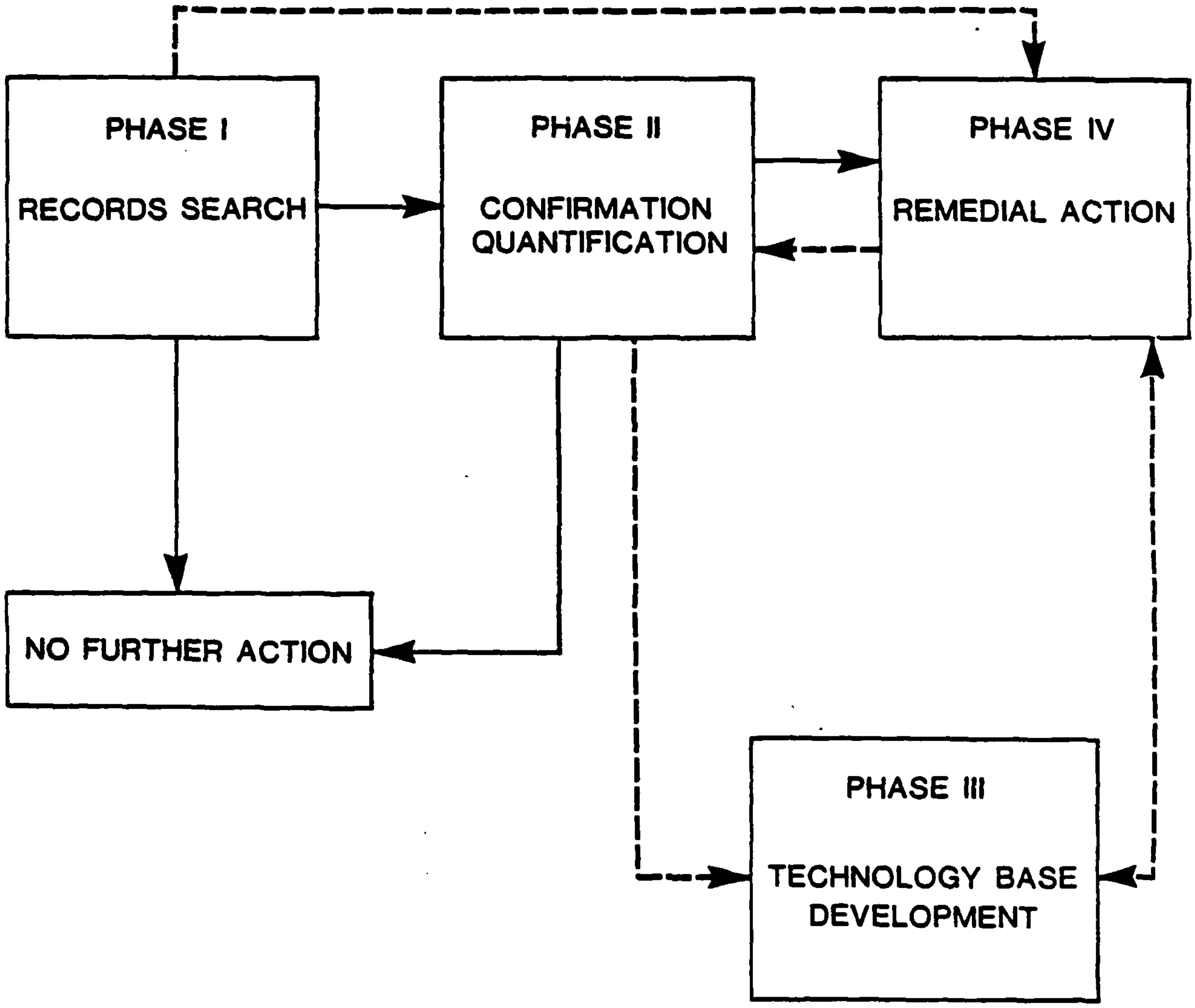
1.2 PURPOSE, AUTHORITY, AND SCOPE OF THE ASSESSMENT

The IRP is a four-phase program, designed as shown in Figure 1.2-1 to ensure that identification, confirmation/quantification, and remedial actions are performed in a timely and cost-effective manner. Each phase is briefly described below:

- Phase I - Installation Assessment/Records Search - Phase I is to identify and prioritize those past disposal sites that may pose a hazard to public health or the environment as a result of contaminant migration to surface or groundwaters or where contaminants have an adverse effect by their persistence in the environment. In this phase, it is determined whether a site requires further action to confirm an environmental hazard or whether it may be considered to present no hazard at this time. If a site requires immediate remedial action, such as removal of abandoned drums, the action can proceed directly to Phase IV. The Phase I report is a basic background document for the Phase II study.

- Phase II - Confirmation/Quantification - Phase II is to define and quantify, by preliminary and comprehensive environmental and/or ecological survey, the presence or absence of contamination, the extent of

U.S. AIR FORCE INSTALLATION RESTORATION PROGRAM



SOURCE: HQ AFESC 1985

E.C.JORDAN CO. CONSULTING ENGINEERS	U.S. AIR FORCE INSTALLATION RESTORATION PROGRAM (IRP) ELEMENTS	
INSTALLATION RESTORATION PROGRAM MASSACHUSETTS MILITARY RESERVATION	TASK 7	FIGURE 1.2-1

contamination, and waste characterization (when required by the regulatory agency) and to identify sites or locations where remedial action is required in Phase IV. Research requirements identified during this phase will be included in the Phase III effort of the program.

- <u>Phase III - Technology Base Development</u> - Phase III is to develop a sound data base upon which to prepare a comprehensive remedial action plan. This phase includes research and implementation of technology development for objective assessment of adverse effects. A Phase III requirement can be identified at any time during the program.

- <u>Phase IV - Operations/Remedial Actions</u> - Phase IV includes the preparation and implementation of the remedial action plan.

To most effectively coordinate the IRP Phase IV the USAF has entered into an interagency agreement with the U.S. Department of Energy to administer Remedial Action Planning (RAP) Programs through the Oak Ridge National Laboratory (ORNL). In December 1985, the Air National Guard (ANG) enlisted the services of and provided funding to ORNL to conduct an IRP for the Massachusetts Military Reservation (MMR) that would ensure a holistic approach. This was deemed necessary because of the complex interrelationships that exist among the various MMR operating agencies. E.C. Jordan Co. (Jordan) was tasked to conduct the program. As a component of the overall program Jordan conducted an initial assessment/records search at MMR. This report comprises the Phase I record search of the U.S. Coast Guard (USCG) Facilities (CG Air Station Cape Cod) located at MMR and contains a summary and evaluation of the information collected during Phase I of the IRP and recommendations for any Phase II action. The Phase I record search of other facilities located at MMR is contained in a separate report developed as a component of the MMR IRP.

The objective of Phase I was to identify the potential for environmental contamination from past waste disposal practices at MMR and to assess the potential for contaminant migration. Activities performed in the Phase I study included the following:

1. Review of site records;

2. Interviews with personnel familiar with past generation and disposal activities;

3. Inventory of wastes;

4. Determination of estimated quantities and locations of current and past hazardous waste treatment, storage, and disposal;

5. Definition of the environmental setting at the base;

6. Review of past disposal practices and methods;

7. Performance of field inspections;

8. An aerial tour of the facilities;

9. Gathering of pertinent information from federal, state and local agencies;

10. Assessment of potential for contaminant migration; and

11. Development of conclusions and recommendations for any necessary Phase II action.

A glossary of acronyms, abbreviations, and selected technical terms used in this report is contained in Appendix A.

Jordan performed the onsite portion of the records search during Ma ch 1986. The following team of professionals was involved:

Michael A. Keirn, Ph.D.	Senior Scientist and Team Leader, Chemist; 21 years professional experience.
Peter S. Baker	Geologist; 4 years of professional experience.
Lisa R. Hoyt	Environmental Engineer; 3 years of professional experience.
Joseph A. Farry	Chemical Engineer; 2 years of professional experience.

Detailed information on these individuals is presented in Appendix B.

1.3 METHODOLOGY

The methodology utilized in the USCG records search began with a review of past and current industrial/laboratory operations conducted at the base. Information was obtained from available records, such as shop files and real property files, as well as interviews with past and current base employees from the various operating areas. Interviewees included current and former personnel associated with the mission of USCG organizations on base. A list of interviewees, by position and approximate years of service, is presented in Appendix C.

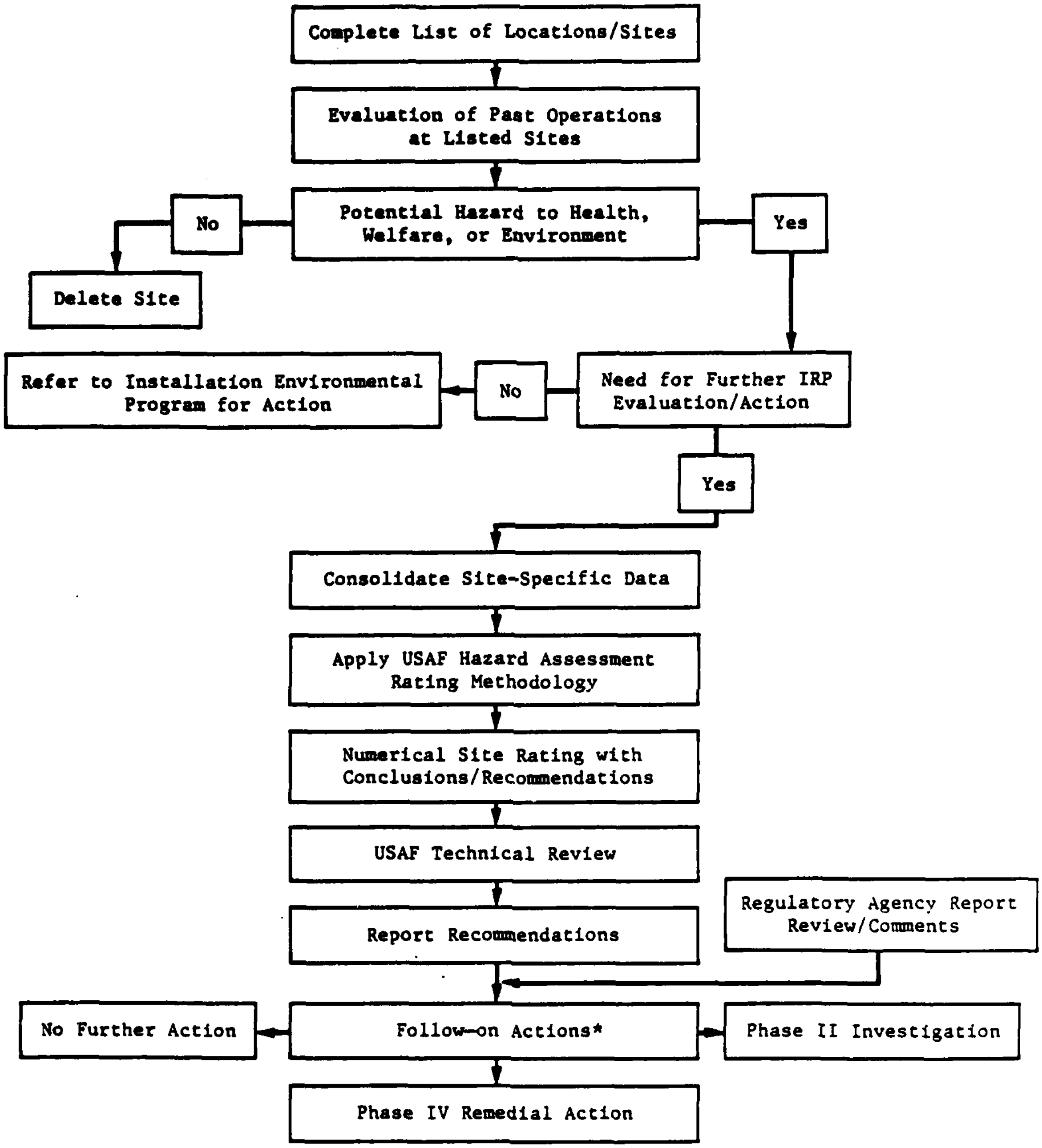
Concurrent with the base interviews, the applicable federal, state, and local agencies were contacted for pertinent base-related environmental data. The outside records centers and agencies contacted and personnel interviewed are also listed in Appendix C.

The next step in the activity review was to determine the past management practices regarding the use, storage, treatment, and disposal of hazardous materials from the various operations on the base. Included in this part of the activities review was the identification of all known past disposal sites and other possible sources of contamination, such as spill areas.

A general ground tour of the identified sites was then made by the Jordan Project Team to gather site-specific information, including (1) visual evidence of environmental stress, (2) the presence of drainage ditches and systems, and (3) visual inspection for any obvious signs of contamination or leachate migration. A helicopter overflight was made as part of the onsite visit to identify possible sites not apparent from the ground.

Using the process shown in Figure 1.3-1, a decision was then made, based on all of the above information, regarding the potential for hazardous material contamination at any of the identified sites. If no potential contamination existed, the site was deleted from further consideration. If potential for contamination was identified, the potential for migration of the contaminant was assessed based on site-specific conditions. If no potential for migration existed and if there were no further environmental concerns, the site was deleted. If the potential for contaminant migration was considered significant, the site was evaluated and prioritized using the USAF Hazard Assessment Rating Methodology (HARM). A discussion of the HARM system is presented in Appendix G.

PHASE I INSTALLATION RESTORATION PROGRAM
RECORDS SEARCH FLOWCHART



*Beyond scope of Phase I

SOURCE: HQ AFESC 1985.

E.C. JORDAN CO. CONSULTING ENGINEERS	DECISION PROCESS	
INSTALLATION RESTORATION PROGRAM MASSACHUSETTS MILITARY RESERVATION	TASK 7	FIGURE 1.3-1

2.0 INSTALLATION DESCRIPTION

2.1 LOCATION, SIZE, AND BOUNDARIES

The MMR is located on the upper or western portion of Cape Cod in Barnstable County, Massachusetts, approximately 60 miles south of Boston and immediately southeast of the Cape Cod Canal. The general location of MMR is shown on Figure 2.1-1. The towns of Bourne, Falmouth, Sandwich, and Mashpee intersect on MMR property.

MMR occupies approximately 20,000 acres and consists of several major cooperating command units as follows:

Massachusetts Army National Guard (ARNG)	(Camp Edwards)
Massachusetts ANG	(Otis-Air National Guard Base)
USAF	(Cape Cod Air Force Station)
USCG	(Air Station Cape Cod)
Veterans Administration (VA)	(Massachusetts National Cemetery)

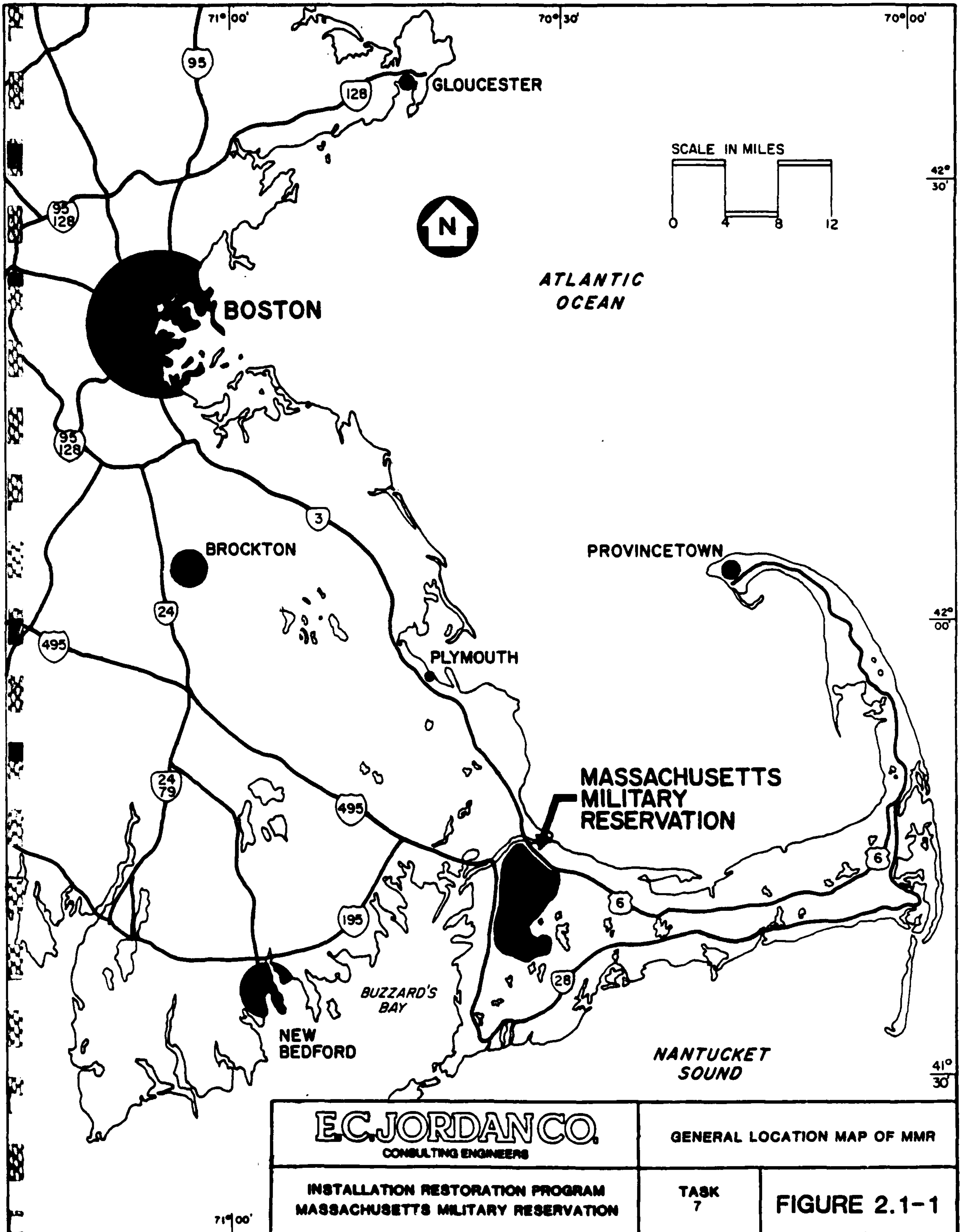
The locations that these units and major tenants occupy on MMR is shown in Figure 2.1-2.

The USCG facilities at MMR consist of four separate areas as shown in Figure 2.1-2. These are the housing and support area, Hangar 128, Hangar 3170, and the Coast Guard Communication Station (COMMSTA) Boston Remote Transmitter Site. Together these facilities comprise 1407 acres (USCG, 1984). Within the housing and support area are located Facilities Engineering, the chapel, the medical dispensary, golf course, base commissary and exchange facilities, work houses, and four separate housing zones. The Hangar 128 area, located among the Otis-ANG Facilities provides a hangar and maintenance facility for USCG fixed-wing aircraft. The Hangar 3170 Area houses USCG Rotary-Wing Aircraft operations. The location of USCG facilities in the main cantonment area of MMR is shown in Figure 2.1-3. The RADSTA Transmitter is located in the range area of MMR and serves the communication surveillance activities of the First Coast Guard District. The complement of Air Station Cape Cod was 325 as of 1983; a total dependant population of approximately 1750 resides in on-base housing (USCG, 1984).

Located within the USCG housing area are three public schools and one private school. These are served by base water supply and support. Three of the schools are owned and operated by the Town of Bourne. These are Stone School (BLDG 5400), Otis Memorial School (BLDG 5500), and Lyle School (BLDG 5700). Falmouth Academy (BLDG 5800) is a private school and leases the building from the Town of Bourne.

2.2 HISTORY

MMR consists of a set of five cooperating command units - the Massachusetts ANG, the Massachusetts ARNG, the USCG, the USAF, and the VA - rather than a host-tenant relationship. A large number of USAF, ANG, and ARNG mission and



GENERAL LOCATION MAP OF MMR

INSTALLATION RESTORATION PROGRAM
MASSACHUSETTS MILITARY RESERVATION

TASK
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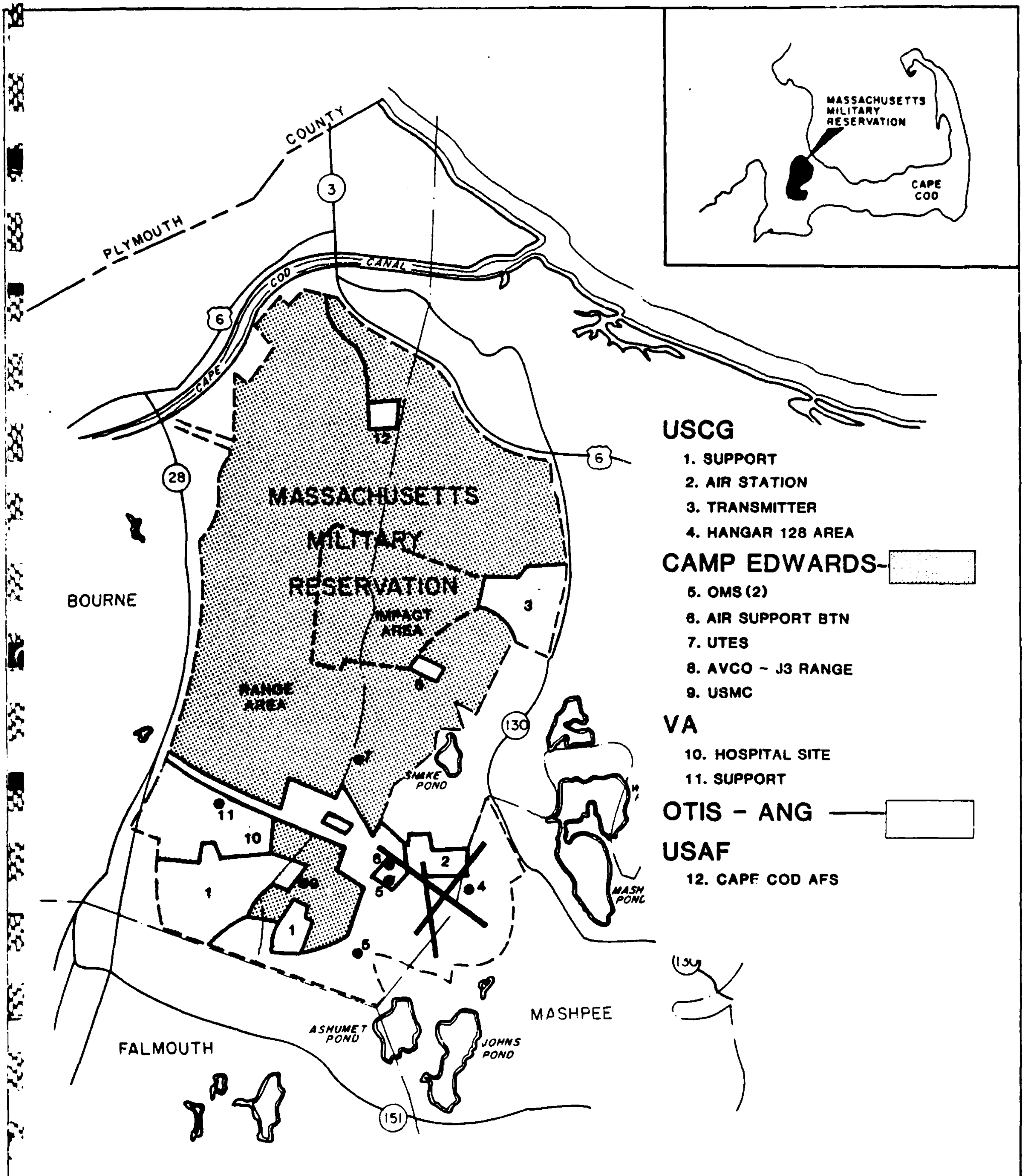
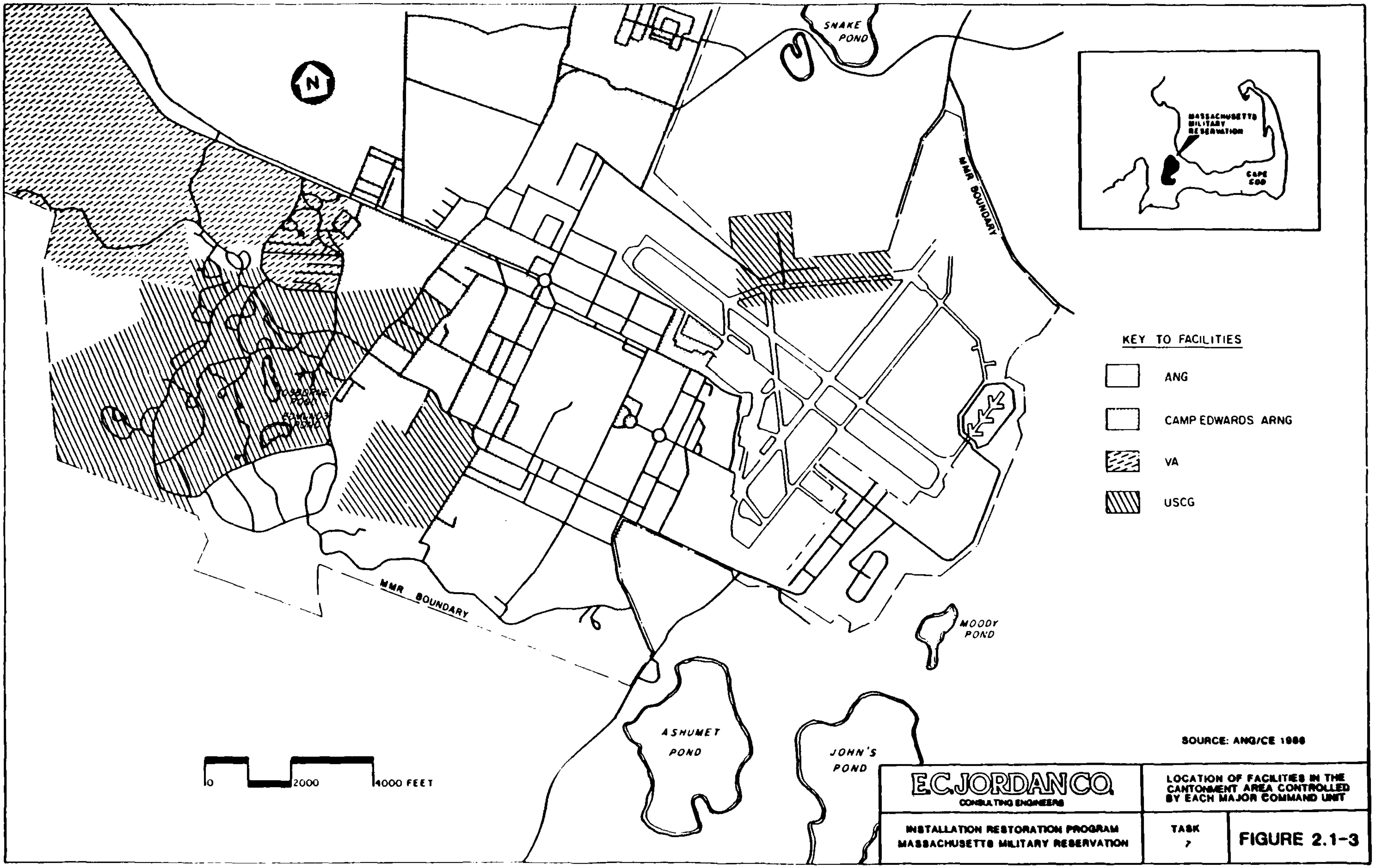
FIGURE 2.1-1



E.C.JORDAN CO. CONSULTING ENGINEERS	LOCATION OF MAJOR UNITS AT MMR	
INSTALLATION RESTORATION PROGRAM MASSACHUSETTS MILITARY RESERVATION	TASK 7	FIGURE 2.1-2



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INSTALLATION RESTORATION PROGRAM
MASSACHUSETTS MILITARY RESERVATION

LOCATION OF FACILITIES IN THE CANTONMENT AREA CONTROLLED BY EACH MAJOR COMMAND UNIT

TASK 7

FIGURE 2.1-3

organization changes have occurred since the MMR began development in 1935. A diagram of the chronology of major activity at MMR is presented in Figure 2.2-1. A description of the history of ANG, ARNG, USAF, and VA activities is presented in a separate report. Operations at Coast Guard Air Station Cape Cod (ASCC) began in 1970 at Otis Air Force Base (AFB). Overall base management was under control of the USAF until 1973, when the facility was transferred from the USAF (4784 Air Base Group) to the 102 Fighter-Interceptor Wing (FIW) of the Massachusetts ANG. The following paragraphs describe the history of ASCC.

The USCG and USAF Aerospace Defense Command (ADC) completed negotiations to relocate Air Station, Salem, Massachusetts, to Otis AFB in May 1964. Permits were granted by ADC in September 1965 to allow the USCG to set up and operate ASCC. Construction and modification of facilities was completed in August 1970, and the relocated air station began full operation.

Activity at ASCC has included both fixed-wing and helicopter stations, support and housing facilities, as well as operation of the COMMSTA Boston Remote Transmitter Site. The remote transmitter facility is not an integral part of the ASCC command structure. The transmitter is operated by COMMSTA Boston.

Air activity at ASCC was first conducted using two HH16 "Albatross" fixed-wing and two HH52A helicopters until 1976, when three additional HH3F aircraft were operated. Originally all aircraft were maintained in BLDG 3170. Fixed-wing aircraft maintenance was moved from BLDG 3170 to BLDG 128 in 1976. Helicopter operations and maintenance currently are conducted from BLDG 3170. Air operations are projected to be combined in a new hangar area by 1987. In 1983 the last HH16 aircraft was replaced by the HH25A "Falcon" jet aircraft.

2.3 MISSION AND ORGANIZATION

The primary mission of ASCC within the first USCG District is air and sea search and rescue. Secondarily, the USCG mission at ASCC includes:

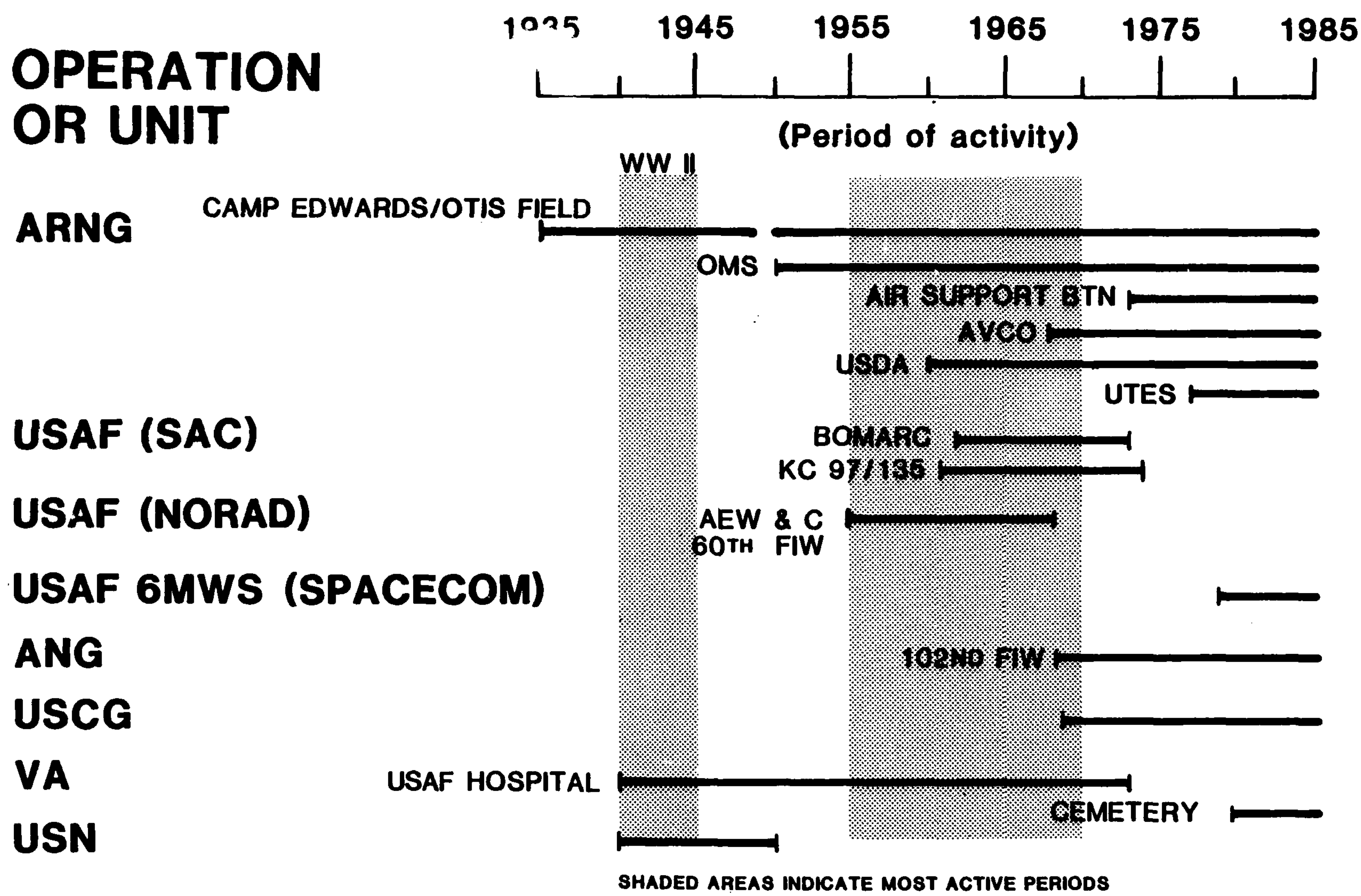
1. Federal Law and Treaty Enforcement on the high seas and territorial waters of the United States,

2. Enforcement of safety regulations on the high seas and territorial waters of the United States,

3. Surveillance for protecting the marine environment, and

4. Maintenance of housing and support facilities to carry out the primary and secondary operational missions.

ASCC has search and rescue responsibility for the area from Watch Hill, Rhode Island to the Canadian border. An average of 400 rescue cases per year are handled. Three HH52 and three HH3F helicopters support this primary mission, service off-shore light houses, and patrol New England bays and harbors for pollution. Four HU25A jet aircraft support the search and rescue mission in locating vessels and aircraft in distress; however, the primary activity of the HU25A is law enforcement and protection of the 200-mile fisheries zone in the



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GENERALIZED CHRONOLOGY OF OPERATIONS AT MMR

INSTALLATION RESTORATION PROGRAM
MASSACHUSETTS MILITARY RESERVATION

TASK 7

FIGURE 2.2-1

area from the Canadian border to Bermuda. The transmitter facility provides communications support to USCG ships and aircraft, the merchant fleet, U.S. Navy, and broadcast services to the maritime public.

ASCC is organized into departments for the performance of operational, support, and administrative duties necessary for accomplishing its mission. Specific staff elements also exist to provide mutual assistance, safety and health, career, religious, and other counseling functions and services. Although under the supervision of the Command Staff, these staff elements have necessary and proper liaison and communication with all departmental elements. The staff and departmental elements are as depicted in Figure 2.3-1. The departments potentially involved in handling, storage, and disposal of hazardous materials are the Medical Department (Dispensary), Facilities Engineering Department, and the Aeronautical Engineering Department.

USCG tenants located at ASCC include the following:

1. Search and Rescue Training School;

2. National Oceanographic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS);

3. Cape Cod Federal Credit Union;

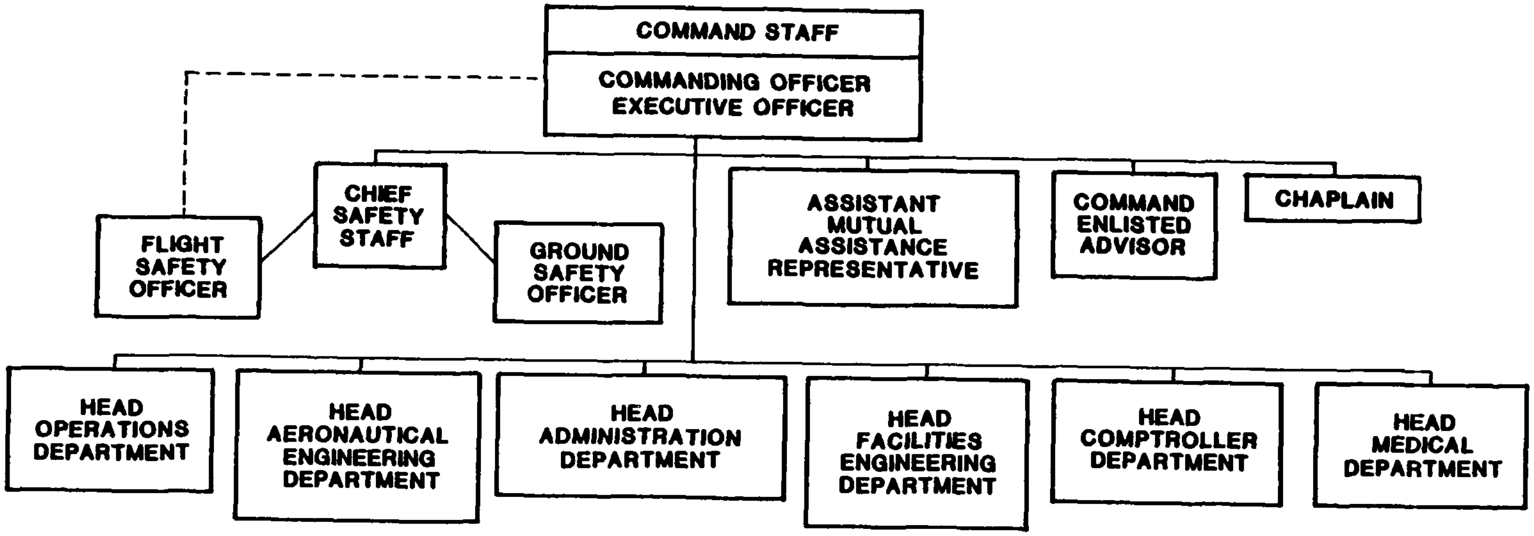
4. Bayside Mental Health Associates;

5. USCG Auxiliary; and

6. First Coast Guard District Intelligence and Law Enforcement Office.

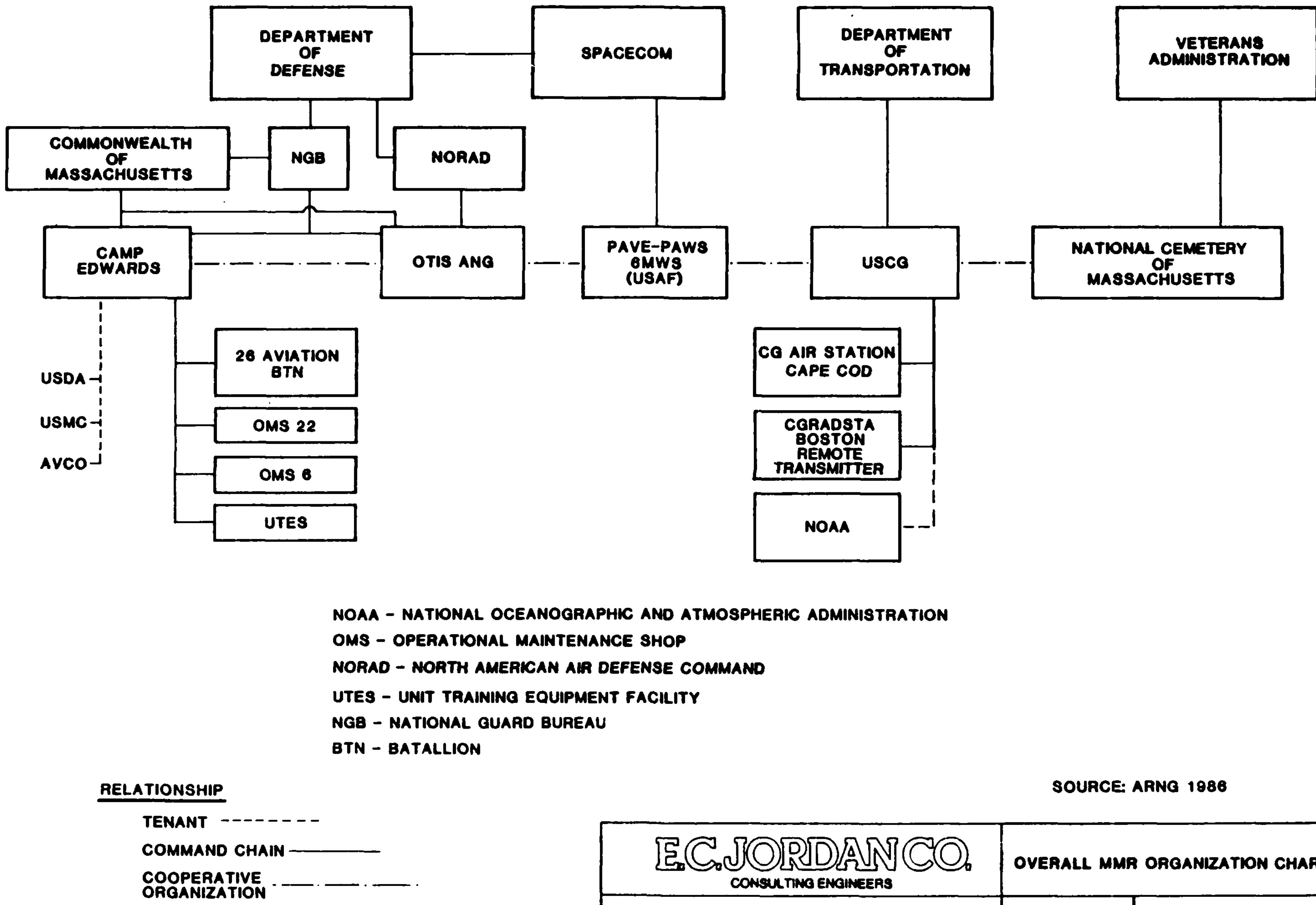
Only the NMFS storage of preserved biological samples has potential for handling hazardous materials.

The overall organizational structure at MMR into which ASCC is integrated is unique. MMR consists of an association of independent command units in which no clear host-tenant relationship exists, and responsibilities are shared among the several military and other governmental agencies. The MMR complex is shared by the Massachusetts National Guard (ARNG and ANG), the USAF, the USCG, and the VA, each with separate commands and no single chain of command. MMR is managed by an association of governing authorities through the individual unit commanders as shown in Figure 2.3-2.



SOURCE: USCG 1984

E.C.JORDAN CO. CONSULTING ENGINEERS	ORGANIZATIONAL STRUCTURE OF COAST GUARD STATION CAPE COD
INSTALLATION RESTORATION PROGRAM MASSACHUSETTS MILITARY RESERVATION	TASK 7 / FIGURE 2.3-1



NOAA - NATIONAL OCEANOGRAPHIC AND ATMOSPHERIC ADMINISTRATION
OMS - OPERATIONAL MAINTENANCE SHOP
NORAD - NORTH AMERICAN AIR DEFENSE COMMAND
UTES - UNIT TRAINING EQUIPMENT FACILITY
NGB - NATIONAL GUARD BUREAU
BTN - BATALLION

SOURCE: ARNG 1986

E.C. JORDAN CO. CONSULTING ENGINEERS	OVERALL MMR ORGANIZATION CHART	
INSTALLATION RESTORATION PROGRAM MASSACHUSETTS MILITARY RESERVATION	TASK 7	FIGURE 2.3-2

3.0 ENVIRONMENTAL SETTING

The section describes the environmental conditions at MMR, including specific site data for meteorology, geology, soils, surface hydrology, geohydrology, water quality, and biota. These data subsequently are used in the HARM scoring system to numerically assess the pollutant transport mechanisms and potential receptors at the site. Appendix G describes the factors used in the HARM system. USCG facilities are spread out in three locations at MMR; the southwestern cantonment area, the northern flightline area, and the eastern range area. Description of the overall environmental setting at MMR is therefore necessary to understand receptors, pathways, and present contamination status.

3.1 METEOROLOGY

Climatological data relevant to MMR are summarized in Table 3.1-1. These data were collected in the cantonment area of MMR. The period of record is 25 years (October 1942 - April 1944 and November 1948 - December 1971).

MMR is located on the extreme upper (landward) portion of Cape Cod. Complete, long-term, NOAA records exist only for mainland locations; partial and short-term records exist for locations further seaward along the Cape. Because of its location in a transition zone between the mainland and outer Cape, the most relevant records for use in contaminant transport assessment are those existing at MMR. The climate at MMR is categorized as a humid continental climate that is modified by close proximity to the Atlantic Ocean. Prevailing winds are from the northwest in the winter November-March and from the southwest in the summer months (April-October). Windspeeds range from an average of 9 mph from July-September to an average of nearly 12 mph in fall and winter (October-March). Short periods of much higher wind velocities (40-70 mph) occur periodically as a consequence of tropical and oceanic storms that pass the Cape.

Precipitation is fairly evenly distributed throughout the year, with the least rainfall occurring in June. The average monthly precipitation is 3.98 in./month throughout the year, with a variation from 2.0 to 4.8 in./month. The annual average rainfall is 47.8 in. Two meteorological factors used in the HARM evaluation are net precipitation and the 1-yr, 24-hr rainfall event. The net precipitation at MMR is similar to Falmouth, Massachusetts, which is 21 in./yr (Metcalf and Eddy 1983). The 1-yr, 24-hr rainfall event is approximately 2.7 in. (U.S. Dept. of Commerce 1961). Infrequent tropical storms passing the Cape may produce 24-hr rainfall events of 5 to 6 in. (U.S. Dept. of Commerce 1961).

All temperature extremes are reduced due to the influence of the Atlantic Ocean, producing milder winters and cooler summers than in inland areas. In February the daily temperature ranges from an average minimum of 23°F to an average maximum of 38°F. In the warmest period of the year, the July average temperature range is from daily lows of 63°F to high temperatures near 78°F. The record high is 99°F, and the recorded low temperature is -10°F.

TABLE 3.1-1

MMR CLIMATOLOGICAL DATA

Month	Temperature (F°) Daily Mean Max.	Temperature (F°) Daily Mean Min.	Temperature (F°) Extreme Max.	Temperature (F°) Extreme Min.	Precipitation (in) Mean	Surface Winds Prevailing Direction	Surface Winds Mean Speed
Jan.	38	24	60	-7	4.8	NW	11
Feb.	38	23	59	-9	4.1	NW	11
Mar.	43	30	68	1	4.3	NW	12
Apr.	53	38	79	18	4.7	SW	11
May	64	47	86	28	3.4	SW	10
Jun.	73	57	97	41	2.0	SW	10
Jul.	78	63	96	47	3.3	SW	9
Aug.	77	62	99	44	4.8	SW	9
Sep.	70	55	89	36	3.9	SW	9
Oct.	62	46	82	22	3.7	SW	12
Nov.	52	37	74	15	4.5	NW	11
Dec.	41	27	65	-10	4.3	NW	12
Annual	57	42	99	-10	47.8	WSW	11

Source = 102nd FIW Weather Office
Period of Record = Oct. 42 - Apr. 44, Nov. 48 - Dec. 71

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3.2 GEOGRAPHY

3.2.1 Physiography

The Cape Cod Peninsula lies in the extreme northern portion of the Coastal Plain Physiographic Province (Hunt 1967) in Southern New England. The MMR is located on two distinct types of terrain on the Cape Cod Peninsula. The main cantonment area lies on a broad, flat, gently southward-sloping glacial outwash plain. Elevations in this area range from 100 to 140 ft above sea level. To the north and west of the cantonment area the terrain becomes hummocky with irregular hills and greater relief. This area lies in the southward extent of terminal glacial moraines. The elevations in this area generally range from 100 to 250 ft. The highest elevation reportedly is 306 ft MSL (Massachusetts ANG 1985). The entire site is dotted with numerous depressions termed "kettle holes," some of which contain water. These are depressions left during glacial recession by melting buried blocks of ice.

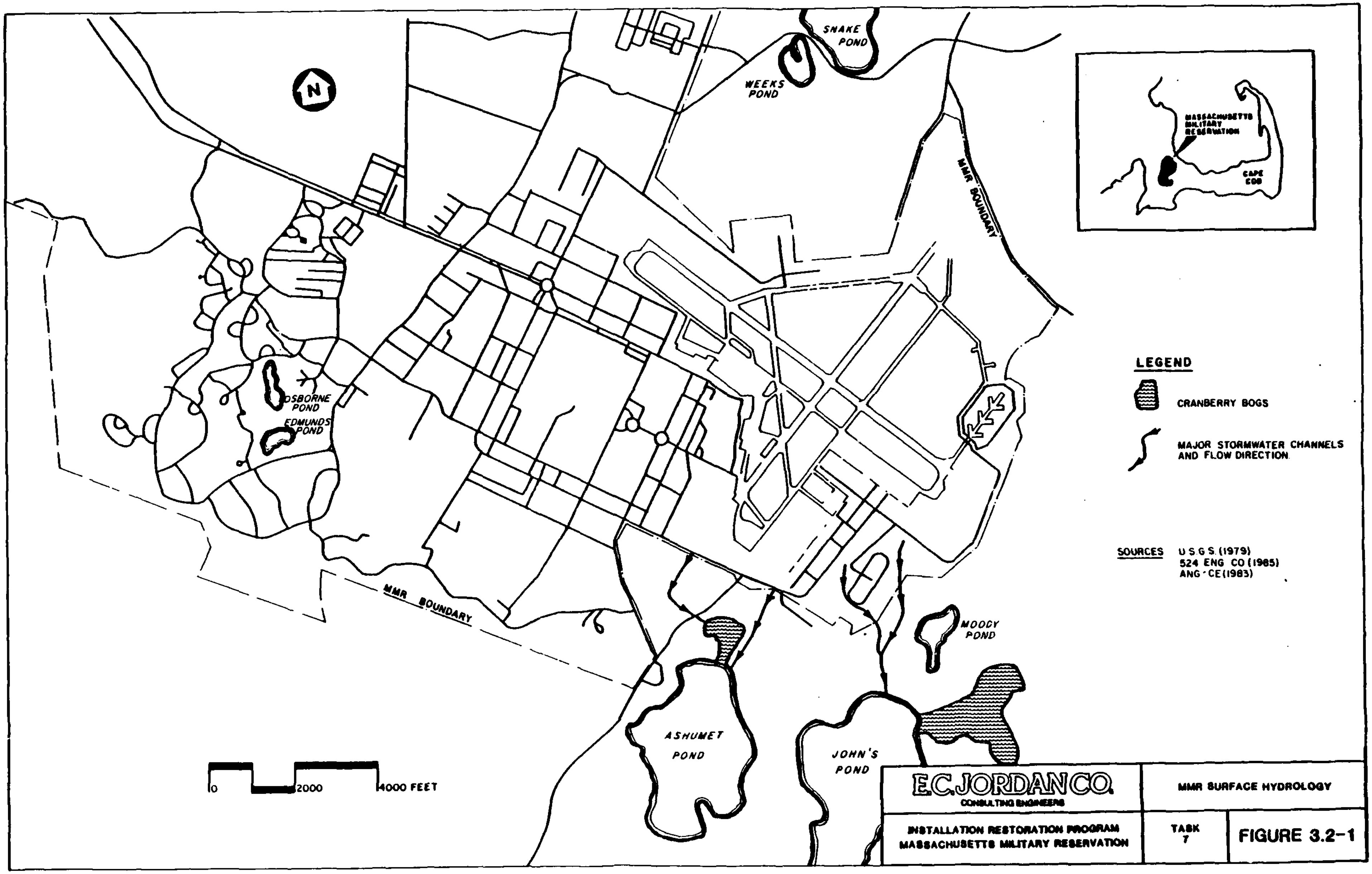
3.2.2 Surface Hydrology

The major surface hydrologic features at MMR are shown in Figure 3.2-1. Surface water runoff at MMR is virtually nonexistent. There are no perennial streams. The highly permeable nature of the sands and gravels underlying the area allow for rapid infiltration of rainfall, which essentially eliminates surface water runoff except on extreme slopes. Intermittent streams are present on MMR in a few of the drainage swales. These intermittent streams begin at the outfall areas of the storm sewer drainage system and are active only during heavy rainfall.

There are two ponds located in the cantonment area of MMR. These are Osborne Pond and Edmunds Pond. Two other unnamed ponds are located at the western boundary of MMR at the Rod and Gun Club. In addition there are 13 small surface water bodies or wetlands located in the range and maneuver area. These are water-filled kettle holes, each of less than 2 acres extent. These small water bodies receive limited runoff from the steep slopes within immediate vicinity. Primarily, they exist at locations where kettle hole depressions intersect the water table. Snake Pond and Week's Pond are located off-base immediately southeast of the range area. Surface topography shows swales leading from the MMR range area toward these ponds. No surface water drainage, however, appears to enter these ponds from MMR.

The storm sewers beneath the flight line area carry runoff from the runways and ramps and also receive wastewater from hangar deck drains and shop drains. The storm drains empty into three open drainage ditches. These ditches lead southward off-base and are components of the watershed of Ashumet Pond and Johns Pond.

Ashumet Pond has no surface outflow and receives the majority of its water input as groundwater (K-V Associates 1986). Two storm drainage courses enter the Ashumet Pond watershed. As shown in Figure 3.2-1, a major drainage ditch from the flight line area discharges to the cranberry bog at the north end of the Pond. A second drainage course enters immediately east of the Cranberry



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MMR SURFACE HYDROLOGY

INSTALLATION RESTORATION PROGRAM
MASSACHUSETTS MILITARY RESERVATION

TASK 7

FIGURE 3.2-1

Bog. The drainage receives storm water from the hangar area and the Petroleum Fuel Storage area located in the southern portion of the flight line area.

The third drainage course enters Johns Pond and drains the extreme eastern portion of the flight line and hangar area. Johns Pond receives groundwater flow from Ashumet Pond and discharges via a cranberry bog to the Quashnet River. The Quashnet River flows south into Waquoit Bay.

According to K-V Associates (1986), limited surface water flow occurs in this drainage course. Sufficient rainfall to develop surface water discharge to Ashument Pond occurs from one to four times per year.

Storm drains in the USCG housing area of MMR discharge to Osborne and Edmunds Pond and to local surface depressions.

3.3 GEOLOGY

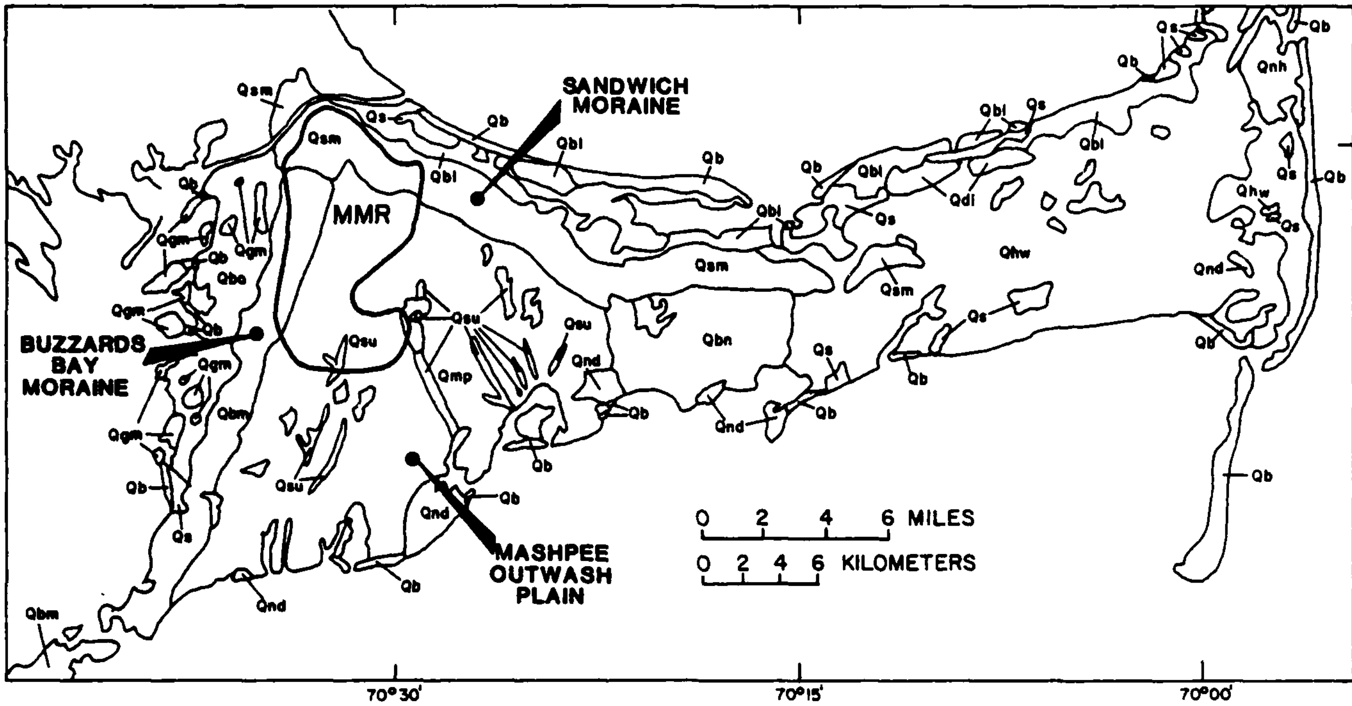
3.3.1 Geologic Setting

The Cape Cod peninsula, which encompasses the MMR, is characterized by geological features that appear to be a result of the last glacial advance. This period of glacial activity, known as the Wisconsin Glaciation, ended approximately 12,000 years ago in Southern New England. The section of ice that covered this area has been named the Laurentide Ice Sheet. Cape Cod was formed from the depositional processes associated with the advance and retreat of the Laurentide Ice Sheet. According to Strahler (1972) glacial deposits generally extend to a depth of 300 to 500 ft below sea level beneath most of Cape Cod, except in the Sandwich-Bourne area, where depths to bedrock are in the range of 150 ft below sea level.

The MMR is characterized by three distinct surficial geologic units. In the northern section of the MMR the east-west trending Sandwich moraine is present. In the Western section the dominant geologic feature is the north-south trending Buzzards Bay Moraine. These two recessional moraines intersect in the northwest corner of the MMR. To the south and east of the moraines, underlying the cantonment area, is the Masphee Outwash Plain. Figure 3.3-1 shows the general locations of these features at MMR. As this figure shows, the cantonment and southeastern portion of the range and maneuver area are located on outwash deposits. The northern and western portions of the range and maneuver area and the VA Cemetery are on moraine formations.

The recessional moraines are an ice contact deposit, formed from boulders, gravel, sand, and silt sloughing off at the ice margin. At MMR, it appears that the rate of advance of the ice sheet was matched by the rate of melting. As a result of the stationary ice margin, the moraines were allowed to develop. The moraines are characterized by a highly variable composition. The soils range from a heterogenous mixture of cobbles, gravel, sand, and silt (till) to stratified sand and gravel (Oldale 1976).

The outwash plain deposit was formed as a result of meltwater carrying sand, silt, and gravel away from the ice margin. These fluvial deposits are characterized by a uniformly graded, unconsolidated, stratified sand and gravel with



Qs, Qb	HALOCENE	QUATERNARY
Qbl	PLEISTOCENE	
Qhw, Qnh		
Qdi		
Qbo, Qsm		
Qgm		
Qbm		
Qmb, Qbn		
Qnd		

Qb	BEACH and DUNE DEPOSITS
Qs	SWAMP and MARSH DEPOSITS
Qbl	BARNSTABLE LAKE DEPOSITS
Qnh	NAUSET HEIGHTS ICE-CONTACT DEPOSITS
Qhw	HARWICH OUTWASH PLAIN DEPOSITS
Qdi	DENNIS ICE-CONTACT DEPOSITS
Qsm	SANDWICH MORAINE DEPOSITS
Qbo	BUZZARDS BAY OUTWASH DEPOSITS
Qgm	BUZZARDS BAY GROUND MORAINE DEPOSITS
Qbm	BUZZARDS BAY MORAINE DEPOSITS
Qbn	BARNSTABLE OUTWASH PLAIN DEPOSITS
Qmp	MASHPEE PITTED PLAIN DEPOSITS
Qbm	NANTUCKET SOUND ICE-CONTACT DEPOSITS
Qsu	SAND AND GRAVEL UNDIFFERENTIATED

SOURCE: OLDALE, U.S.G.S. 1972

E.C. JORDAN CO. CONSULTING ENGINEERS	GENERALIZED GEOLOGIC MAP OF UPPER CAPE COD	
INSTALLATION RESTORATION PROGRAM MASSACHUSETTS MILITARY RESERVATION	TASK 7	FIGURE 3.3-1

traces of silt. Recent geologic data indicates the presence of lenses of silt and peat in subsurface soil in certain areas at the southern boundary of MMR (USGS 1986).

The outwash plain and the moraine terrain are pitted with numerous depressions called kettles. Kettles were formed from isolated blocks of ice that became covered by outwash deposits. When the ice blocks melted a depression was formed as sediments caved in to fill the void. Many of these kettles now contain surface water bodies.

Underlying the surficial deposits is a basal till consisting of a fine silty sand with some clay (Oldale 1976). The basal till is thought to have been deposited as a result of sediments being ground and smeared along the bedrock surface as the glacial ice sheet advanced.

The bedrock has been mapped as a granodiorite (Oldale and Tuttle 1964). A general cross section of the southern area of the MMR and the immediate off-base area downgradient are shown in Figure 3.3-2. This figure illustrates the general relationship of the coarse outwash material that overlies the finer sand and silt and dense till.

3.3.2 Soils

Soils at MMR can be separated into two general zones. These zones correspond to the surficial geology. The soils found in the moraine terrain are of the Plymouth-Canton-Carver association. The Plymouth and Carver soils are excessively drained and are characterized by highly permeable sandy subsoil with a gravelly sand substratum. The Canton soils are well drained and consist of a fine sandy loam mantle (20 to 30 in. thick), with a gravelly, loamy sand substratum.

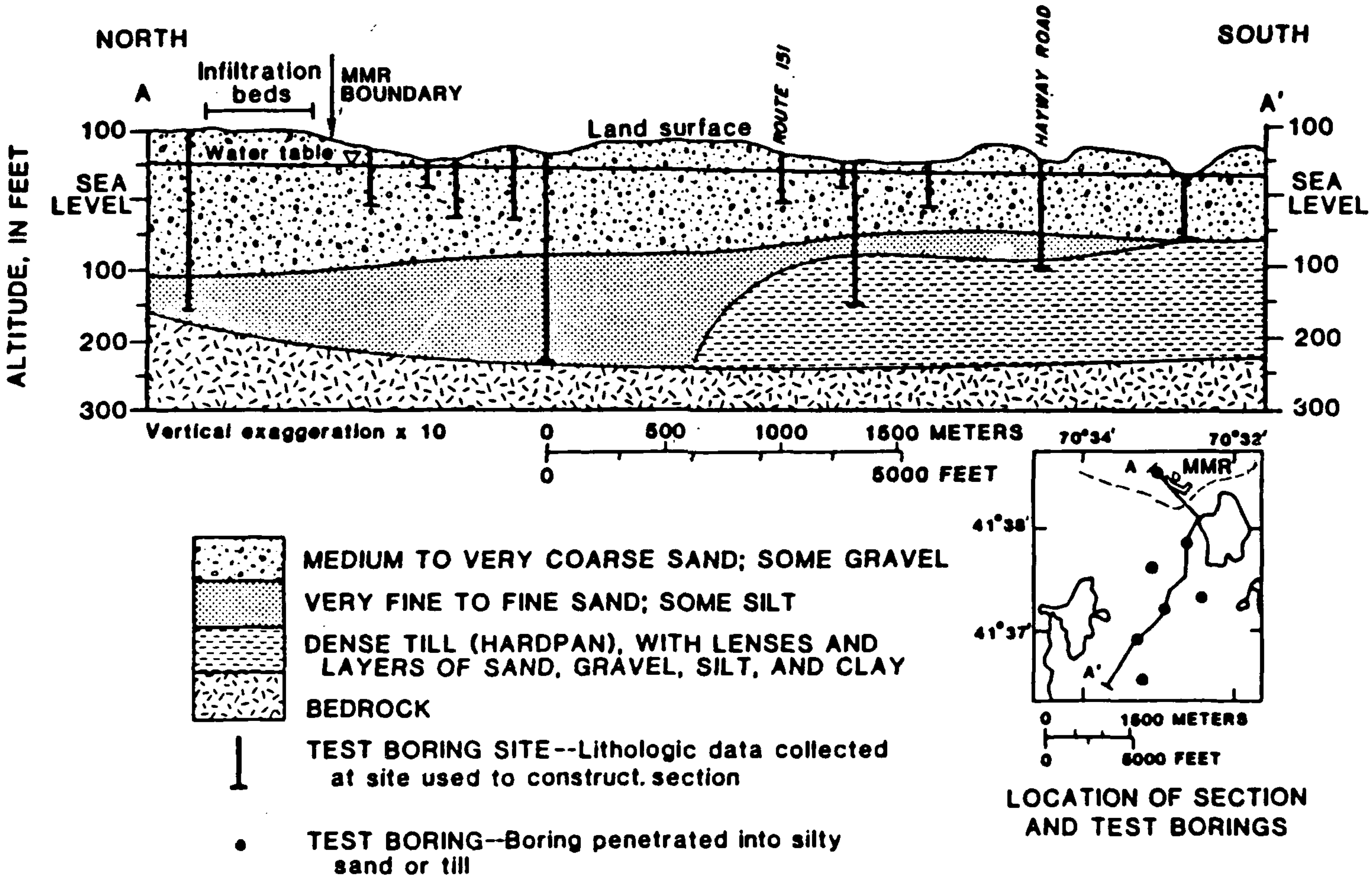
In the outwash terrain, the dominate soil types are of the Aqawam or Enfield Series. The Aqawam soils are well drained and consist of a sandy loam surface soil and subsoil. Typically they are free of gravel to a depth of 3 ft. The Enfield soils are well drained and are characterized by a crumbly silt loam surface soil and subsoil to a 2-ft depth. Substratum in both these soil types is a stratified sand and gravel.

In general, the soils at MMR are Spodosols, characterized by a low cation exchange capacity and a low base saturation level. Soil pH is in the 5.0 to 6.0 range. Figure 3.3-3 and Table 3.3-1 illustrate the soil types and their locations at MMR.

3.3.3 Hydrogeology

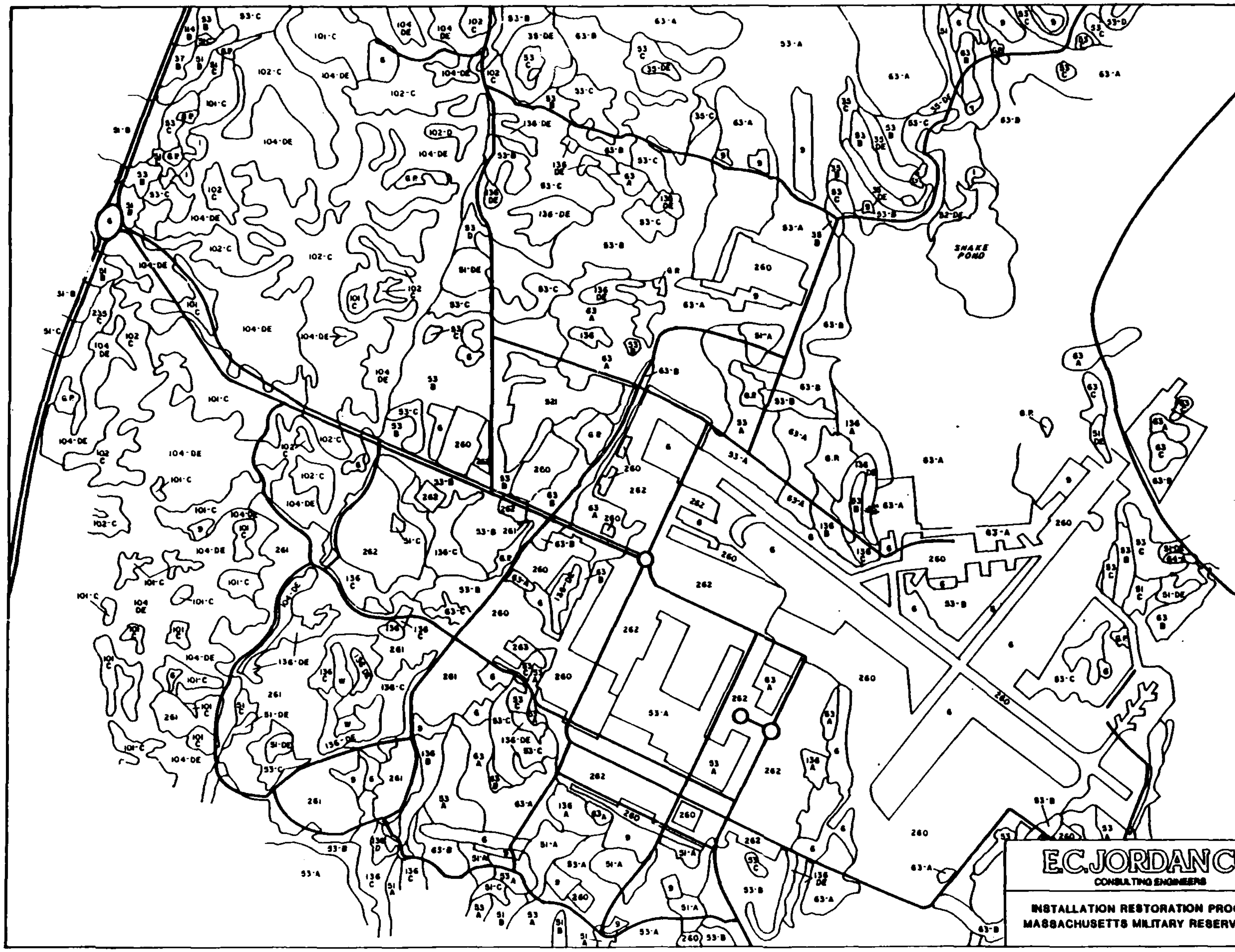
Groundwater Environment

Cape Cod consists of unconsolidated glacial deposits. These deposits constitute an aquifer, which serves as the primary source of water for the residents of Cape Cod. According to the U.S. EPA, this aquifer has been designated as a "sole source aquifer." The aquifer is bounded laterally by the Atlantic Ocean, Cape Cod Bay, Cape Cod Canal, and Nantucket Sound. The upper zones of the



SOURCE: LeBlanc 1984

E.C.JORDAN CO. CONSULTING ENGINEERS	GENERALIZED GEOLOGIC CROSS SECTION FROM THE SOUTHERN PORTION OF MMR	
INSTALLATION RESTORATION PROGRAM MASSACHUSETTS MILITARY RESERVATION	TASK 7	FIGURE 3.3-2



U.S. SOIL CONSERVATION SERVICE,
BARNSTABLE CO. 1986

E.C. JORDAN CO.
CONSULTING ENGINEERS

MMR CANTONMENT AREA SOILS MAP

INSTALLATION RESTORATION PROGRAM
MASSACHUSETTS MILITARY RESERVATION

TASK 7

FIGURE 3.3-3

TABLE 3.3-1

SOIL TYPES AT MMR
(KEYED TO FIGURE 3.3-3)

Soil Map Symbol	Field Soil Name	Soil Map Symbol	Field Soil Name	Soil Map Symbol	Field Soil Name	Soil Map Symbol	Field Soil Name
1	Freetown and Swansea Muck	51C	Carver Coarse sand, 8 to 15 percent slopes	99	Freetown, ponded	235DE	Plymouth stony loamy sand 15 to 35 percent slopes
6	Udipsamments, smooth	51DE	Carver Coarse sand, 8 to 35 percent slopes	101C	Plymouth-Canton-Carver complex, bouldery, 5 to 15 percent slopes	260	Urban land
7	Freetown coarse sand	53A	Agawam fine sandy loam, 0 to 3 percent slopes	102C	Plymouth-Canton-Carver complex, very bouldery, 5 to 15 percent slopes	261	Carver-Urban land complex, 0 to 5 percent slopes Carver soils 50%
9	Stripped land, sand, and gravel	53B	Agawam fine sandy loam, 3 to 8 percent slopes	103DE	Plymouth-Canton-Carver complex, very bouldery, 15 to 35 slopes	262	Agawam-Udipsamments-Urban complex, 1 to 5 percent slopes Agawam soils - 30% Udipsamments - 30%
10	Stripped land, glacial till	53C	Agawam fine sandy loam, 8 to 15 percent slopes	104DE	Plymouth-Carver-Canton Complex, extremely bouldery, 15 to 35 percent slopes	GP	Pits, gravel
35B	Plymouth loamy sand, 3 to 8 percent slopes	53D	Agawam fine sandy loam, 15 to 35 percent slopes	201C	Canton fine sandy loam, 3 to 8 percent slopes	521	Sanitary landfill
35C	Plymouth loamy sand, 8 to 15 percent slopes	63A	Enfield very fine sandy loam, 0 to 3 percent slopes	201C	Canton-Plymouth-Carver Complex, stony, 5 to 15 percent slopes	W	Water
35DE	Plymouth loamy sand, 15 to 35 percent slopes	63B	Enfield very fine sandy loam 3 to 8 percent slopes	203DE	Plymouth-Carver-Canton Complex, stony, 15 to 35 percent slopes		
37B	Merrimac fine sandy loam, 3 to 8 percent slopes	73A	Hinesburg loamy sand, 0 to 3 percent slopes	235B	Plymouth stony loamy sand, 3 to 8 percent slopes		
51A	Carver coarse sand, 0 to 3 percent slopes	74B	Amostown fine sandy loam, 3 to 8 percent slopes	235C	Plymouth stony loamy sand, 8 to 15 percent slopes		
51B	Carver coarse sand, 3 to 8 percent slopes						

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aquifer beneath the cantonment area are comprised of unconsolidated sand and gravel containing trace quantities of silt. These deposits overlie fine to very fine sand and silt. To the north and west in the moraine systems, the aquifer consists of a mixture ablation till and sand and gravel deposits (USGS 1984).

The groundwater in the vicinity of MMR exists under unconfined or "water table" conditions. The MMR complex lies at the highest elevations in the Upper Cape, therefore groundwater flows out in all directions from the reservation. Figure 3.3-4 shows the regional groundwater configurations. Figure 3.3-5 shows the groundwater table configurations beneath the southern portion of the base. This area is the portion of MMR in which most previous studies and disposal operations have occurred. According to USGS (1984) the saturated thickness of the aquifer generally decreases to the south of MMR. Because of its location on the highest elevation in the Upper Cape, MMR is a major recharge area for the aquifer. Groundwater recharging in the western and northern portions of the range and maneuver area provides the water supply for portions of the town of Bourne and Sandwich. Groundwater recharging in the cantonment area moves south generally toward Mashpee and Falmouth.

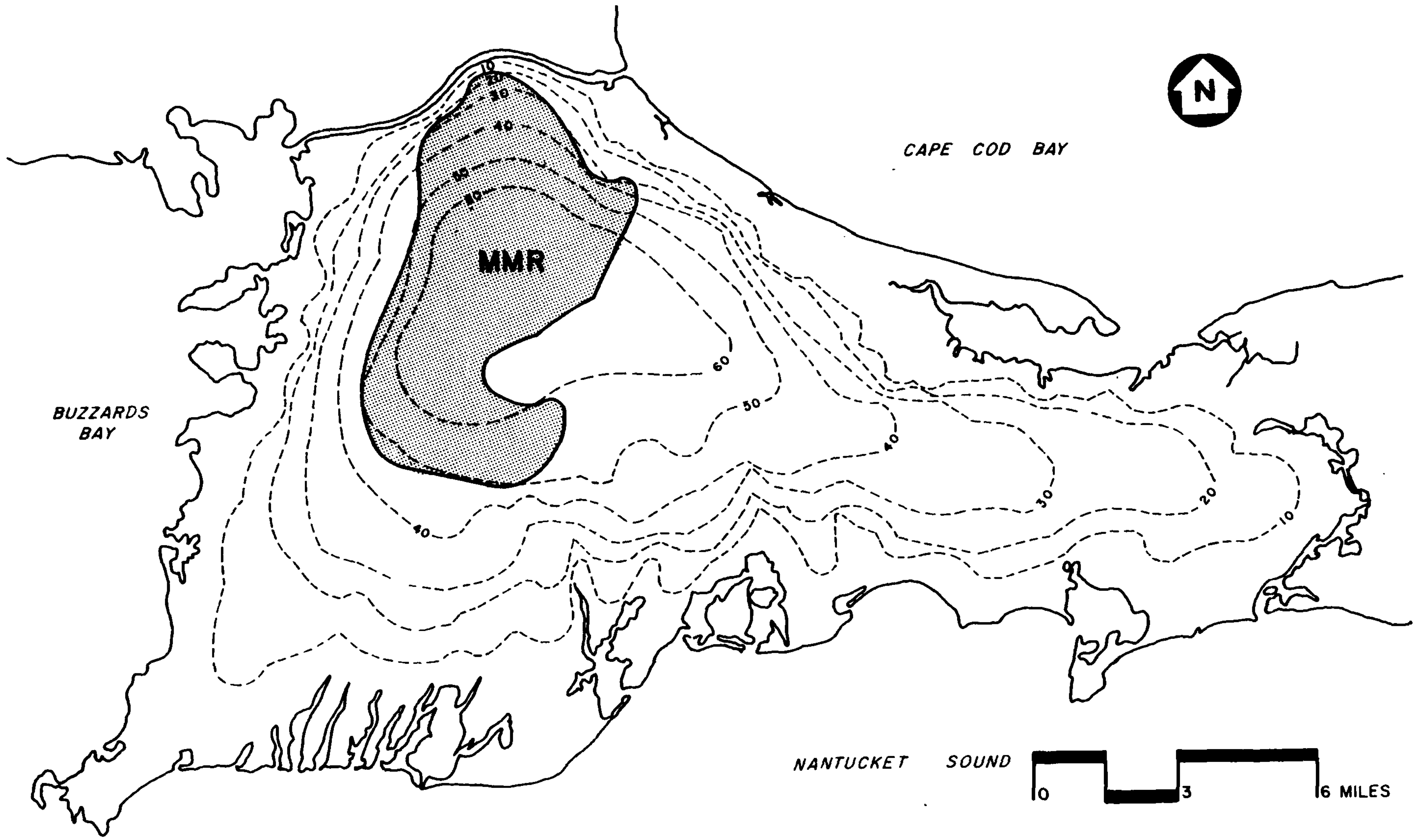
Recharge to the aquifer is from precipitation and inflow from adjacent parts of the aquifer. The average annual recharge is approximately 21 in., which is roughly half the average annual precipitation (see Section 3.1). Half of the precipitation is lost to evaporation and evapotranspiration. The depth to groundwater is greatest below the moraine areas with depths to groundwater in excess of 100 ft common in the range and maneuver areas. In general, the depth to groundwater beneath the cantonment area averages about 50 ft, and decreases to the south. Immediately south of MMR the land surface elevation rapidly drops off and depth to groundwater is 0 to 20 ft below the land surface along a valley in the vicinity of Ashument Pond.

The unconsolidated sand and gravel deposits have a high permeability due to their coarse texture and sorted deposition. The horizontal hydraulic conductivity, as estimated by USGS (1984), is in the range of 200 to 300 ft/d. With an average groundwater gradient of 0.03 percent the groundwater flow velocity therefore probably averages 0.8 to 2.3 ft/d. Vaccaro et al (1985) have suggested that anisotropic conditions may exist within the aquifer. Such a condition would create differences in groundwater flow rates depending on the direction of flow, with maximum horizontal hydraulic conductivities following the general north-south depositional stratigraphy. Vaccaro et al (1985) indicate a possible east-west hydraulic conductivity at 18 to 21 ft/d and a north-south hydraulic conductivity of 140 to 167 ft/d. Data are limited on this subject, and the extent to which anisotrophy exists has not been defined.

The vertical hydraulic conductivity is likely lower than the horizontal because of the layered depositional environment, but is also relatively high due to the general coarse texture of the upper layers of unconsolidated materials.

Installation Water Wells

Potable water at MMR is produced from groundwater supply wells. The original supply system, installed in 1941, included four gravel-packed screened, steel

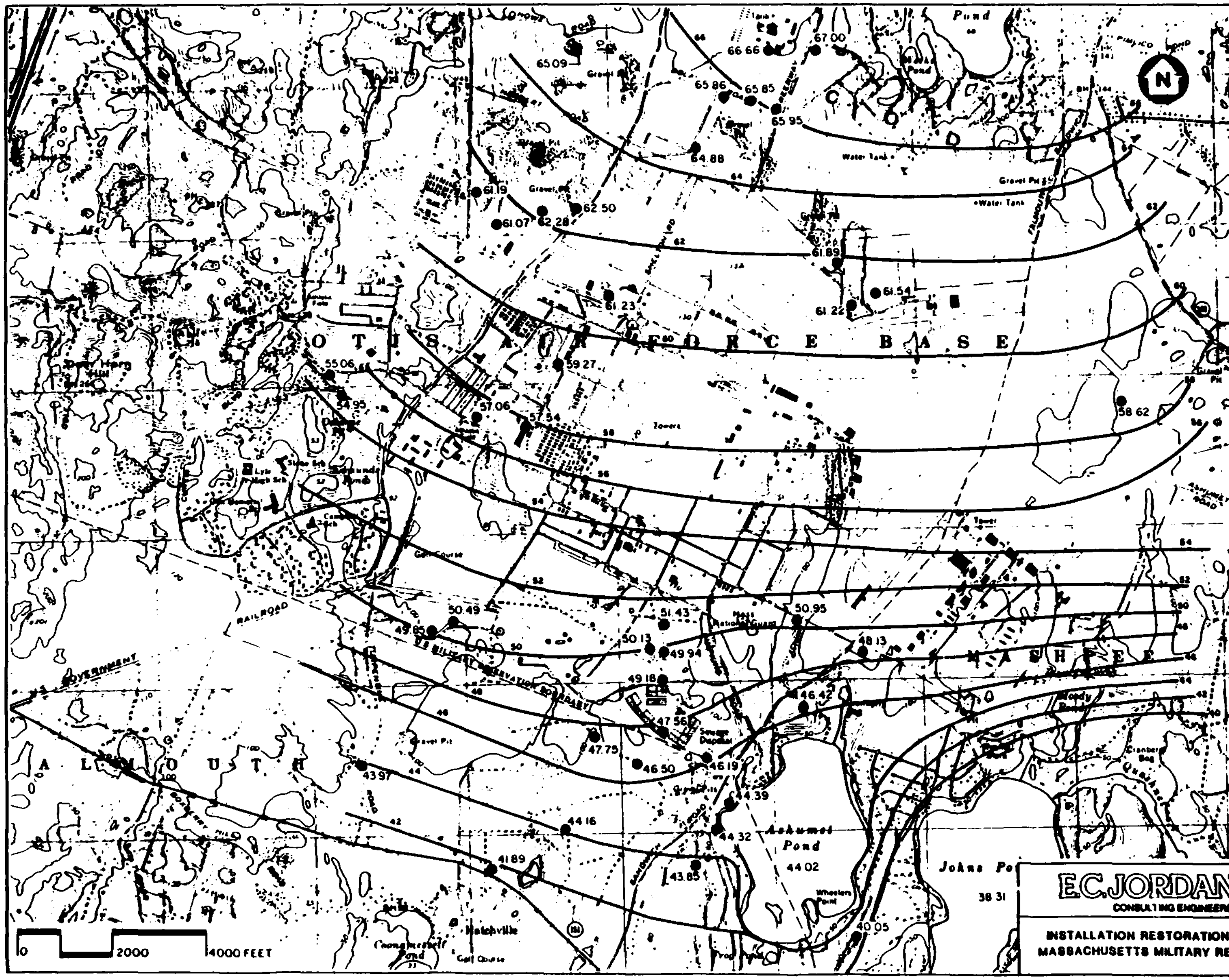


LEGEND

--10-- OBSERVED AVERAGE WATER TABLE CONTOUR, IN FT DATUM IS SEA LEVEL, CONTOUR INTERVAL 10 FT.

SOURCE: USGS 1984

E.C. JORDAN CO. CONSULTING ENGINEERS	REGIONAL GROUNDWATER CONFIGURATION	
INSTALLATION RESTORATION PROGRAM MASSACHUSETTS MILITARY RESERVATION	TASK 7	FIGURE 3.3.4



LEGEND

● MONITORING WELL USED FOR WATER LEVEL MEASUREMENTS

42 LINE OF CONSTANT GROUNDWATER LEVEL

NOTE: BASE MAP PREPARED FROM U.S.G.S POCASSET QUADRANGLE 1:25,000 1979

E.C.JORDAN CO. CONSULTING ENGINEERS	WATER TABLE MAP MAY 6, 1986	
INSTALLATION RESTORATION PROGRAM MASSACHUSETTS MILITARY RESERVATION	TASK 7	FIGURE 3.3-5

wells (Wells B, E, G, and J) and pumping stations. Of the four original wells, only one (Well J) is presently in use. In addition to these wells, there are water supply wells located at the Coast Guard Transmitter Station, Cape Cod AFS, AVCO, Inc., and the VA Cemetery. All of the water supply wells are situated in the unconsolidated sand and gravel unit that contains the aquifer. The location of these wells is shown in Figure 3.3-6. Characteristics of the wells are summarized in Table 3.3-2. The wells range in depth from 40 to 412 ft below ground surface. Water demand at MMR is seasonal, with peak demand occurring during June though August when the highest level of training exercises occur. As stated previously, Well J is the only water supply well producing water for the cantonment area. Its maximum capacity is 1,350 gpm. The drawdown to the well at this capacity is approximately 5.7 ft. The capture zone for this well extends 1000 ft to the east and west of the well, and the zone of influence has been estimated to extend out 1000 ft in radius from the well location. Some of the water supply wells have been closed due to contamination. The contamination status of the water supply wells is discussed in Section 3.4.2.

3.4 WATER QUALITY

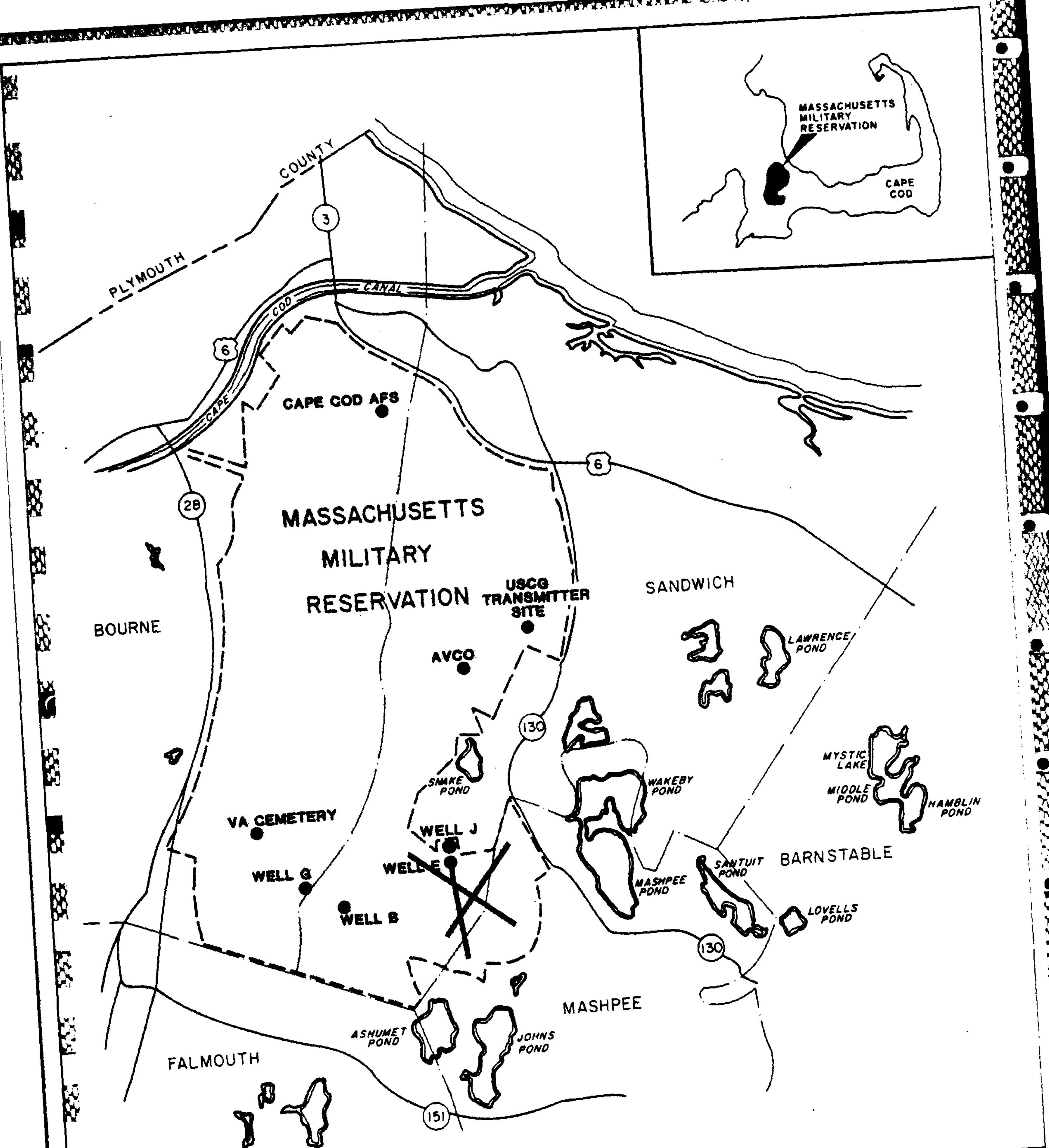
3.4.1 Surface Water Quality

As described in Sections 3.2.1 and 3.2.2, MMR is situated in an area with infrequent surface water runoff due to the highly permeable nature of the soil. There are no perennial streams located on the Reservation. Two ponds are located in the western portion of the cantonment area - Edmunds Pond and Osborne Pond. There are several additional depressions in the range, impact, and maneuver area that contain water and have formed ponds, bogs, or small wetland areas. Two unnamed ponds are located at the western edge of MMR at the Rod and Gun Club (see Section 3.2.2).

No comprehensive surface water quality studies have been performed for the surface water of MMR. The surface water quality data base on MMR is limited to a single 1984 sampling of Osborne Pond. The kettle hole ponds on the Reservation have been classified as Class B under the Massachusetts Water Quality Standards for Surface Water. Class B surface waters are designated for the use, protection, and propagation of fish, other aquatic life, and wildlife and for secondary contact recreation (314 CMR 4.03). Class B surface water quality standards for MMR are summarized in Appendix E.

Deep Bottom Pond has been partly dredged for use as an engineering training area. This activity is no longer carried out, and the pond is off-limits for any activities. There is some evidence of minor siltation in Donnely Pond as a result of runoff from a nearby dirt road.

As described in Section 3.2.2, storm drains from the Coast Guard housing area discharge into the Osborne Edmunds Ponds watersheds. The sampling and analysis of Osborne Pond in 1984 was limited to primary and secondary contaminants regulated under the National Primary Drinking Water Regulations and National Secondary Drinking Water Regulations. Maximum contaminant limits for these parameters are presented in Appendix E. The parameters measured included



E.C. JORDAN CO. CONSULTING ENGINEERS	MMR WATER SUPPLY WELL LOCATIONS	
INSTALLATION RESTORATION PROGRAM MASSACHUSETTS MILITARY RESERVATION	TASK 7	FIGURE 3.3-6

TABLE 3.3-2

MMR WATER SUPPLY WELLS

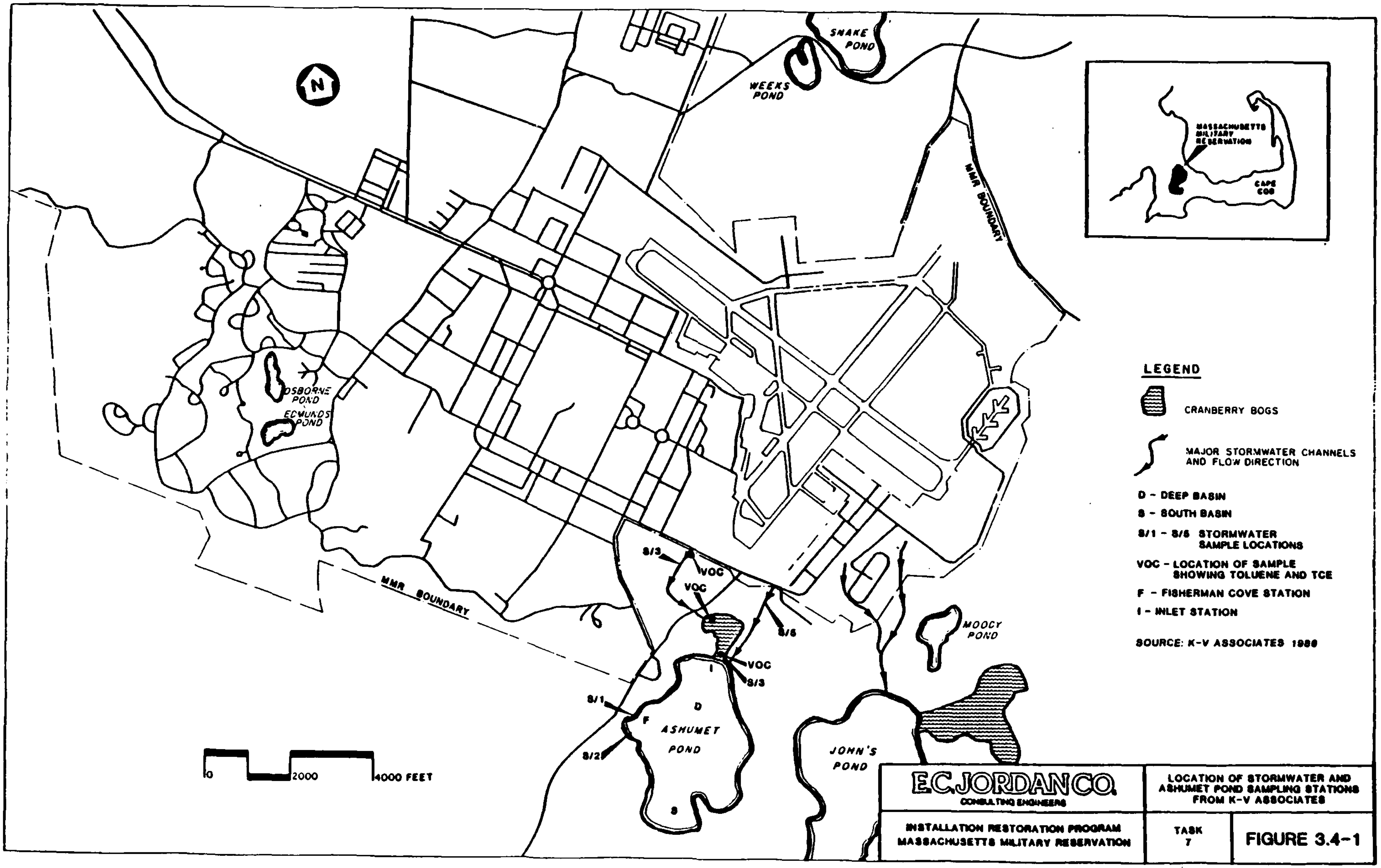
Well I.D.	Depth Below Land Surface (ft)	Diameter I.D.	Screen Type	Screen Length (ft)	Comments
J	86	24	Steel	45	Current base water supply
B	84	24	Steel	45	Abandoned as potable water due to contamination (1962) used for irrigation of USCG; golf course
G	91	24	Steel	45	Shut down due to contamination (15 Nov 1985)
E	117	24	Steel	50	Dismantled to provide runway clearance
USCG Transmitter Station	110	12	--	50	Installed due to contamination found in previous well
Cape Cod AFS	412	20	Stainless Steel	20	
VA Cemetery	200	8	Stainless Steel	50	
AVCO, Inc.	40	--	--	--	
	85	--	--	--	

chloride, color, fluoride, total dissolved solids, sulfate, surfactants, turbidity, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, silver, zinc, and nitrate. None of these exceeded their respective maximum contaminant level (MCL). Nitrate concentration was <0.1 mg/L as nitrogen. No organic compounds, pesticides, or PCBs were measured. Osborne Pond water quality data are tabulated in Appendix F.

A limited study of stormwater runoff water quality was performed in 1985 by K-V Associates to determine nutrient and metals entering the Ashumet Pod watershed from the drainage of the MMR flight line, petrol fuel storage area, and south-eastern portion of the base. Stormwater sampling locations are shown in Figure 3.4-1. Table 3.4-1 shows the composited results of the stormwater sampling. As shown in this table, elevated nitrogen concentrations typical of suburban storm water (EPA 1979) were observed in the runoff. Iron, copper, manganese, and zinc were detected in the storm water. Copper and zinc were observed at concentrations greater than the short-term Federal Water Quality Criteria (EPA 1980 and 1985) for protection of aquatic life. According to a 1984 Massachusetts Department of Environmental Quality Engineering (DEQE) report, (Duerring and Rojko, 1984), Ashumet Pond total hardness ranges from 11 to 26 mg/L as $CaCO_3$. This is similar to groundwater in the area (USGS 1984). Based on this hardness level, the Federal Water Quality criterion (EPA 1980, 1985) was 0.002 mg/L for copper and 0.050 mg/L for zinc. Contaminations of copper and zinc at the boat ramp and beach at Fishermans Cove were higher than those from the MMR drainage. The concentration of these materials at both locations is typical of storm runoff from urban and suburban watersheds (EPA 1979). The impact on Ashumet Pond from these metals would be expected to be mitigated to an extent by dilution. No sampling for metals has been conducted in Ashumet Pond. A single sample from the oil water separator discharge was screened by K-V Associates for volatile organics. No volatile organics were detected in this discharge.

Both Ashumet Pond and Johns Pond have been sampled in conjunction with the Massachusetts Lake Classification Program and the Massachusetts Clean Lakes Program (Chapter 628 of the Commonwealth Acts of 1981). Summaries of these results, taken from Duerring and Rojko (1984), are contained in Appendix F. The results of these surveys indicated that Ashumet Pond was classified as mesotrophic/eutrophic. Johns Pond was classified as mesotrophic. Both ponds have been responding to inputs of nitrogen and phosphorus resulting from watershed development. As a result of continued eutrophication of Ashumet Pond, a diagnostic/feasibility study is being conducted under sponsorship of the towns of Mashpee and Falmouth to determine the sources of nitrogen and phosphorus and to develop alternatives for eutrophication control.

Data collected in Ashumet Pond during the summer and fall of 1985 are summarized in Table 3.4.2. Locations of the sampling stations are shown in Figure 3.4-1. According to K-V Associates (1986), Ashumet Pond was classified as an oligotrophic lake in 1969. The nutrient status and relative population sizes of the algae and aquatic plants of a lake are used to determine its trophic state. An oligotrophic lake is generally considered to contain low concentrations of total nitrogen and total phosphorus; sustain relatively low primary productivity; be free from algal blooms and nuisance aquatic vegetation; and have a very small oxygen demand in the bottom waters after summer and/or winter



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LOCATION OF STORMWATER AND ASHUMET POND SAMPLING STATIONS FROM K-V ASSOCIATES

INSTALLATION RESTORATION PROGRAM
MASSACHUSETTS MILITARY RESERVATION

TASK 7

FIGURE 3.4-1

TABLE 3.4-1

STORMWATER QUALITY IN THE ASHUMET POND WATERSHED

Parameter	Concentrations in Composite Samples (mg/L) Fishermans Cove Beach	Fishermans Cove Boat Ramp	Cranberry Bog	Oil/Water Separator
Ammonia Nitrogen	0.44	0.90	0.49	0.23
Nitrate Nitrogen	0.43	0.16	0.28	0.10
Total Kjeldahl Nitrogen	2.50	2.41	1.74	1.74
Cadmium	<0.010	<0.010	<0.010	<0.010
Chromium	<0.02	<0.02	<0.02	<0.02
Copper	0.02	0.04	0.02	<0.02
Iron	13.8	1.01	2.46	0.56
Lead	<0.01	<0.10	<0.10	<0.10
Manganese	0.20	0.05	0.64	0.04
Zinc	0.07	0.11	0.05	0.07

Source K-V Associates (1986)

TABLE 3.4-2

SUMMARIZED 1985 WATER QUALITY STATUS
OF ASHUMET POND
(SEE FIGURE 3.4-1 FOR STATION LOCATIONS)

Water Quality Parameter (Units)	Station Identification: Deep Basin, Epilimnion/Metalimnion Mean (No. of Samples)	Deep Basin, Epilimnion/Metalimnion Range	Deep Basin, Hypolimnion Mean (No. of Samples)	Deep Basin, Hypolimnion Range	South Basin Mean (No. of Samples)	South Basin Range	Cranberry Bog Outlet Mean (No. of Samples)	Cranberry Bog Outlet Range	Fishermans Cove Mean (No. of Samples)	Fishermans Cove Range
pH (Standard Units)	6.3(14)	5.5-7.2	5.9(7)	5.5-6.6	6.4(6)	6.1-7.1	5.9(8)	5.1-6.8	6.4(7)	5.9-7.1
Specific Conductance (umho/cm @ 25°C)	89.75(12)	85-110	95.5(6)	85-110	84.2(5)	75-89	85.71(7)	60-95	87.17(6)	79-95
Total Alkalinity (mg/L as $CaCoH_3$)	10.07(14)	7-25	15.0(7)	9-22	9.5(6)	8-11	14.63(8)	7-23	10.0(7)	8-12
Chloride (mg/L)	10.94(14)	10.1-12.0	11.01(7)	9.86-12.2	10.93(6)	10.5-11.5	8.70(8)	5.5-12.0	12.17(7)	10.3-15.0
Total Dissolved Solids (mg/L)	54.14(14)	30-80	53.57(7)	30-68	40.16(6)	13-60	59.75(8)	22-90	48.14(7)	22-78
Total Kjeldahl Nitrogen (mgN/L)	0.74(14)	0.26-1.74	1.10(7)	0.45-1.76	0.58(6)	0.28-.90	1.13(8)	0.44-2.16	0.56(7)	0.05-1.63
Ammonia Nitrogen (mgN/L)	0.25(14)	0.05-0.77	0.63(7)	0.05-1.29	0.16(6)	0.05-0.26	0.35(8)	0.05-0.63	0.30(7)	0.05-1.22
Nitrate Nirtogen (mgN/L)	0.18(13)	0.04-0.36	0.19(6)	0.06-0.60	0.19(6)	0.04-0.38	0.22(8)	0.16-0.31	0.21(7)	0.11-0.33
Total Phosphate (mgp/L)	0.012(14)	0.005-0.028	0.041(7)	0.005-0.133	0.009(6)	0.005-0.017	0.029(8)	0.005-0.053	0.012(7)	0.005-0.023
Dissolved Inorganic Phosphate (mgp/L)	0.009(14)	0.005-0.022	0.038(7)	0.005-0.131	0.006(6)	0.005-0.008	0.026(8)	0.005-0.053	0.01(7)	.005-0.023

Source: K-V Associates (1986)

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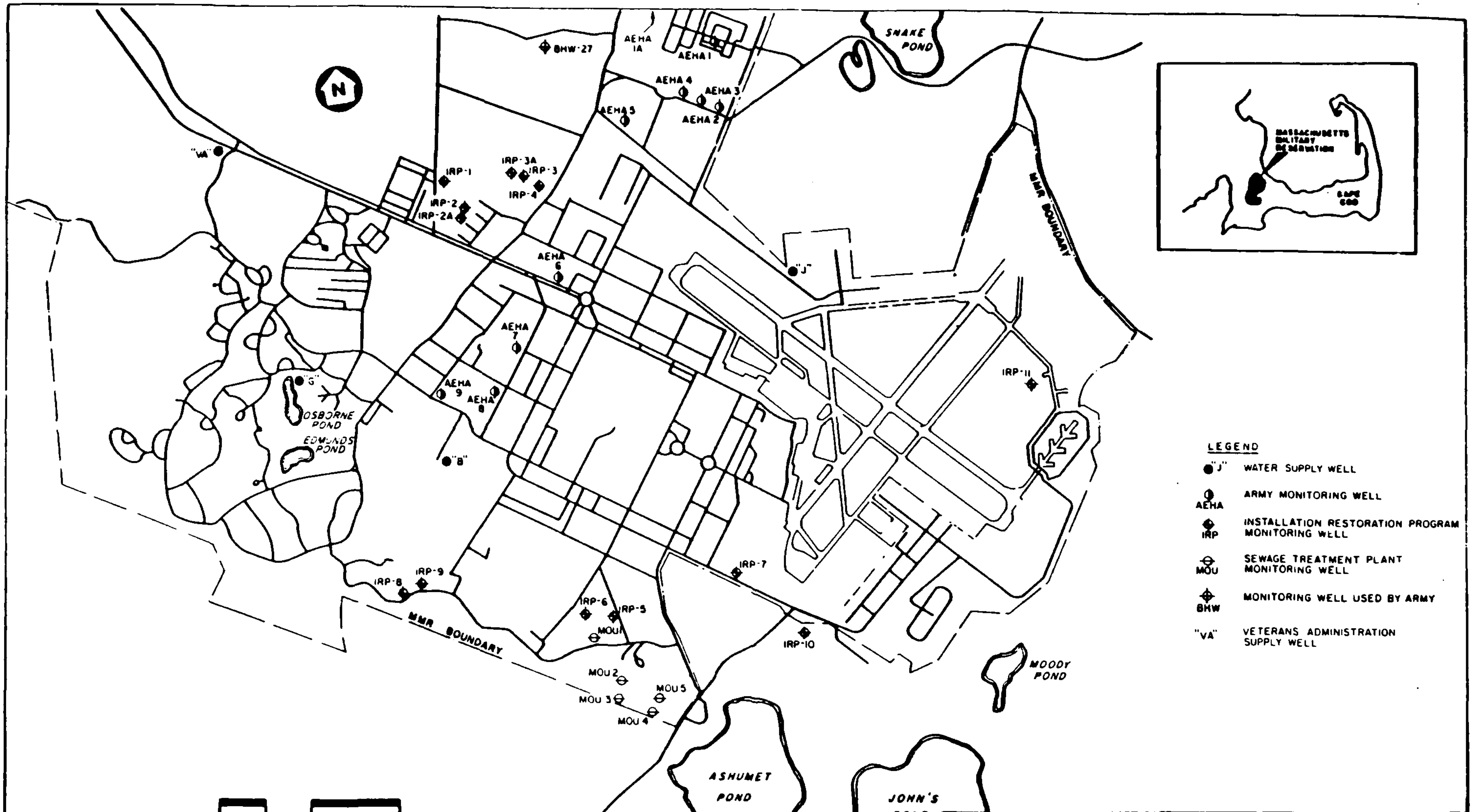
thermal stratification. A lake that is mesotrophic to eutrophic contains higher levels of nitrogen and phosphorus and therefore supports larger populations of algae and aquatic plants. As a consequence, algal blooms and aquatic weed nuisance conditions may occur. The oxygen demand in the bottom waters becomes greater and low dissolved oxygen concentrations occur after stratification in the bottom water layers. As the level of nutrients increases a lake shows a trend toward eutrophication. The available data for Ashument Pond for 1980 and 1985 suggest such a trend, which leads toward water quality degradation. A partial fish kill occurred in Ashumet Pond during the summer of 1985. This kill has been described in K-V Associates 1986. Ashumet Pond is located less than 0.5 miles south of MMR and receives the majority of its water input as groundwater. A portion of the recharge comes from the southeastern sector of MMR, which includes effluent from the base sewage treatment plant (STP).

The natural surfacewater inlets to Ashumet Pond are located at the north end of the pond. These consist of a cranberry bog and a second drainway. There is no surfacewater outlet. Following a heavy rain event, surface water will discharge from a MMR storm drainway into the cranberry bog located at the north end of the pond and directly into the pond from the second drainway in the same area as the cranberry bog inlet. The locations of these drainage ways and their hydrologic properties were described in Section 3.2.2. Dissolved volatile organic compounds (VOCs) have been detected in the cranberry bog and the inlet to Ashumet Pond (K-V Associates, 1986). Toluene was detected at concentrations of up to 93 ug/L and trichloroethylene (TCE) at 9.0 ug/L. Water samples taken at the Ashumet Pond boat landing contained detectable concentrations of VOCs, but at concentration levels less than 1 ppb (USGS 1984). Because of the potential for impact to Ashument Pond from MMR, an evaluation of Ashumet Pond is being conducted as a separate task within the MMR IRP program.

3.4.2 Groundwater Quality

The quality of the groundwater at MMR has been closely monitored during the last two years. There are presently 28 monitoring wells located on base. These include: 12 IRP wells installed in 1983 as a part of the R.F. Weston Phase II, Stage 1 investigation; five Memorandum of Understanding (MOU) wells installed in 1981 to satisfy an agreement with EPA; 10 U.S. Army Environmental Hygiene Agency (AEHA) monitor wells installed in 1985; and BHW-27, an observation well installed in 1940 and included in the AEHA program. In addition to the monitoring wells, there are eight water supply wells on base. Figure 3.4-2 shows the locations of the monitoring wells in the cantonment area. In addition to the four water supply wells shown in Figure 3.4-2, two wells are located at the AVCO facility on J-3 range, one at the USCG Transmitter site, and one at the Cape Cod AFS. An additional water supply well (Well E) has been dismantled.

Water quality data for MMR water supply wells exist for periodic samples collected during the period 1948-1982 and have been tabulated in the Otis-ANGB Phase I report (Metcalf and Eddy 1983). No systematic data collection occurred during 1983-1984. In late 1985, however, at the direction of the NGB, a systematic monitoring program was implemented at the MMR (by Otis Air National Guard Base (ANGB) Civil Engineering and Medical Services) to quantify VOCs observed in the base water supply and water distribution system. These VOC



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MASSACHUSETTS MILITARY RESERVATION

WELL LOCATIONS

TASK 7

FIGURE 3.4-2

results, as well as a single 1985 OEHL analysis, are summarized in Appendix F. Water distribution systems sampling has focused on the water quality at the four schools located on MMR.

In addition to the on-base groundwater analysis programs, two major studies are ongoing off-base to the south of MMR. The USGS has been studying the migration of inorganic and organic compounds as related to the land disposal of sewage effluent from the base STP. These results have been reported in USGS (1984). Because of the findings in the USGS Report (1984) and contamination that caused abandonment of one town of Falmouth public water supply well located south of MMR, a program of sampling private wells south of MMR has been implemented by the Boards of Health of Mashpee, Falmouth, and Sandwich in conjunction with the Barnstable County Health Department. In addition, during 1985, the Otis ANGB Medical Service conducted a sampling program at more than 200 privately owned wells in the Ashumet Pond area of Falmouth and Mashpee.

Detailed evaluation of these groundwater data as well as additional sampling and analysis are ongoing as components of separate MMR-IRP tasks. In addition, Barnstable County and MMR are continuing to conduct systematic monitoring and sampling of the base water supply and domestic wells to the south of MMR. The following paragraphs summarize the most important groundwater quality results at MMR.

Historical data for the MMR supply wells reported in Metcalf and Eddy did not show violations of Federal Primary or Secondary Drinking Water Standards (these standards are presented in Appendix E). In this historical data base, VOCs were analyzed for Well "J" and Well "G." No VOCs were detected in a single sample from Well J. Well G showed evidence of VOC contamination as summarized in Table 3.4-3. Well G, former water supply well, was closed on November 15, 1985 due to contamination by VOCs. Those detected in the 1985-1986 program (see Appendix F) were tetrachloroethylene (PCE), trichloroethylene (TCE), 1,1,1 trichloroethane (TCA), trihalomethanes, trichlorofluoromethane, and dichlorodifluoromethane. PCE was found in concentrations up to 42 µg/L. No federal drinking water standard currently exists for this compound. The concentrations of the other compounds found were below the proposed MCLs. Proposed MCLs for VOCs are tabulated in Appendix E. The recommended maximum contaminant level (RMCL) for PCE has not been promulgated by EPA because recent mammalian toxicity testing for this compound is currently under public review. If the toxicity data are accepted, a final RMCL of 0 mg/L (the current proposed RMCL) may be promulgated. In this event, the MCL may be set in a manner analagous to the testing of the proposed MCL for TCE. Should this occur, an MCL for PCE of 5 ug/L would result.

Well J, the present water supply well, showed concentrations of 5 µg/L of TCE on November 18, 1985 and 4.8 µg/L on November 10, 1985 (see Appendix F). The proposed federal drinking water MCL for TCE is 5 µg/L. In addition, concentrations of up to 3.8 µg/L of PCE were detected in Well J.

Well B was abandoned as a potable water supply in 1962 due to phenolic contamination and has been used solely for irrigation of the golf course since that time.

TABLE 3.4-3

SUMMARY OF VOLATILE ORGANIC COMPOUNDS FOUND IN MONITORING WELL G (6/79 THROUGH 4/82)

Parameter	Concentration Range (ug/L)	Number of Samples
Methylene Chloride	ND	6
1,1-Dichloroethylene	ND	5
1,1-Dichloroethane	ND	4
1,2-Trans-Dichloroethylene	ND	5
Chloroform	0.5-2.3	10
1,2-Dichloroethane	ND	6
1,1,1-Trichloroethane	ND-12.8	12
Carbon Tetrachloride	ND-5.5	10
Dichlorobromomethane	ND-1.0	8
Trichloroethylene	ND-8.0	12
Dibromochloromethane	ND-2.9	8
Bromoform	ND-0.7	7
Tetrachloroethylene	0.9-3.0	8
1,2-Dichloroethylene	ND	2
1,1,2,2-Tetrachloroethylene	ND-3.0	6
Toluene	1.5	1

ND - Not Detected, detection limit not given.
Source: Metcalf and Eddy (1983)

Among the other water supply wells on the MMR, a recent sampling showed the VA well to be free of detectable levels of organic contamination. In addition, no inorganic contaminants detected exceeded federal primary or secondary drinking water standards in that well. Likewise, the water supply at the AVCO facility and at Cape Cod AFS meet federal drinking water standards. No VOC analyses have been performed at the AVCO or Cape Cod AFS water supply wells. The water quality at the Coast Guard Transmitter Station shows trace amounts (10.0 µg/L) of 1,1,1 TCA. It should be noted that the original well at the Transmitter Station was abandoned due to contamination. At this time the type and amounts of contamination at the abandoned well are undocumented.

VOCs were also detected in the IRP monitoring wells installed in the Phase II, Stage 1 IRP program at MMR by R.F. Weston Inc. (1985). Figure 3.4-2 shows the location of these wells. Well installation in this program was designed for verification of groundwater quality status at six locations recommended for study by the 1983 Phase I Study (Metcalf and Eddy 1983) and one additional site added as a result of the Phase II, Stage 1 presurvey. These sites are described in Section 4.0-6.0 of the Phase II report and are also components of additional sampling and analysis under other tasks in the current MMR-IRP program. Table 3.4-4 is summarized from the Weston (1985) data and indicates VOC contamination of MMR groundwater. In addition to halogenated solvents, methyl isobutylketone (MIBK) was detected.

Petroleum, oils, and lubricants (POLs)-related contamination was also detected in the IRP monitoring wells (see Table 3.4-4). Oil and grease were detected in well RFW-1 - RFW-9. POL-related VOCs (toluene, xylenes, and ethyl benzene) were also detected as shown in Table 3.4-4.

Among the AEHA Wells, see Appendix F (Table F-4), sampled in July 1985, AEHA-1 contained concentrations of PCE (16 µg/L) and TCE (8 µg/L). AEHA-6 contained PCE (7 µg/L). Similarly, AEHA-27 (BHW-27) contained concentrations of PCE (23 µg/L). The locations of these wells are topographically downgradient of the former BOMARC site and the current UTES facility as shown in Figure 3.4-2.

Benzene was detected in water from Well J taken July 19, 1985, during AEHA sampling at a concentration of 16 ug/L. This compound has not been detected in any other analysis since or before this time. No other VOCs normally associated with POL, such as xylenes, toulene, or ethyl benzene, were detected. No other sampling events have detected this compound in Well J. Therefore, it is probable that the benzene detected was a laboratory or sampling artifact.

The MOU Wells, installed in the vicinity of the STP (see Figure 3.4-2) contain VOC contamination. Most notable are the amounts of PCE in MOU Wells 1, 2, and 4. The concentrations are 10, 16, and 7.1 µg/L, respectively. Also, 13 µg/L of TCE was detected in MOU-2.

LeBlanc (1984) has characterized the groundwater quality off-base downgradient of the STP. These data indicate a plume of sewage-effluent-related compounds in excess of 8,000 ft in length downgradient of MMR. VOC contamination was observed in wells downgradient of the STP. These VOC results are summarized in Appendix F. The USGS is continuing studies of groundwater quality in the area downgradient of MMR. Results of these studies are under review by USGS and are

TABLE 3.4-4

SUMMARY OF OTIS-ANGB PHASE II STAGE 1 GROUNDWATER ORGANICS DATA (FROM R.F. WESTON, 1984)
(SEE FIGURE 3.4-2 FOR WELL LOCATIONS)

Parameter	Detection Limit	RFW-1	RFW-2A	RFW-3A	RFW-4	RFW-5	RFW-6	RFW-7	RFW-8	RFW-9	RFW-10	RFW-11
Phenol (mg/L)	0.005 mg/L	0.007	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Oil & Grease (mg/L)	0.1 mg/L	1.03	0.15	2.0	0.24	2.29	0.26	2.09	0.16	0.13	ND	ND
GC Hydrocarbon Scan (mg/L)	1 mg/L	NA	NA	NA	NA	NA	NA	NA	ND	ND	ND	ND
Carbon Tetrachloride (μg/L)	2.0 μg/L	ND	ND	ND	2.8	NA	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane (μg/L)	4.0 μg/L	ND	11	5.0	6.1	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene (μg/L)	3.0 μg/L	22	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride (μg/L)	2.0 μg/L	ND	4.2	6.5	2.0	NA	NA	NA	NA	NA	NA	NA
1,2-Trans Dichloroethylene (μg/L)	2.0 μg/L	7.6	4.2	ND	ND	ND	5.6	ND	ND	ND	NA	NA
Tetrachloroethylene (μg/L)	2.0 μg/L	ND	3.5	ND	ND	7.1	3.0	ND	ND	ND	NA	NA
1,1,1-Trichloroethane (μg/L)	2.0 μg/L	ND	ND	ND	9.0	NA	NA	NA	NA	NA	NA	NA
Trichloroethylene (μg/L)	2.0 μg/L	ND	18	ND	ND	2.4	ND	ND	ND	ND	NA	NA
Ethyl Benzene (μg/L)	2.0 μg/L	6.4	ND	ND	ND	ND	ND	ND	ND	2.8	59	ND
Trichlorofluoromethane (μg/L)	3.0 μg/L	ND	ND	ND	3.0	NA	NA	NA	NA	NA	NA	NA
Total Xylenes (μg/L)	4.0 μg/L	ND	ND	ND	ND	ND	ND	ND	ND	4.6	78	ND
Methyl Ethyl Ketone (μg/L)	10.0 μg/L	ND	ND	ND	ND	81	ND	ND	ND	ND	ND	ND
Methyl Isobutyl Ketone (μg/L)	4.0 μg/L	5.3	ND	ND	ND	ND	ND	ND	ND	210	ND	ND

NA - Not Analyzed
ND - Not Detected

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being coordinated with off-base groundwater data being generated as a component of other MMR-IRP tasks.

The analyses of private wells that have been conducted to date by the Otis ANGB Medical Service and Barnstable County from over 200 households indicate that a total of approximately 40 wells in Falmouth and Mashpee contain low levels of VOCs. The principal areas in which groundwater contamination has been detected are located downgradient with respect to groundwater flow from the Reservation and include the Ashumet Valley area of Falmouth, the Briarwood area in Mashpee, and the Tri-Town Circle and Horseshoe Bend Way area of Mashpee. The principle organic chemicals detected include TCE, PCE, 1,1,1-TCA, and 1,1-dichloroethane (DCA). Concentrations detected ranged from not detected (ND), which is generally less than 1 µg/L (ppb) for VOCs, to 125 µg/L. Table 3.4-5 summarizes the results from the sampling events to date in these communities.

In summary, there appears to be contamination of groundwater at MMR by organic compounds. In addition, VOC contamination has been documented off-base downgradient of MMR. Phase II Stage 1 and Stage 2 groundwater characterization programs are ongoing both on-base and off-base in the area of observed VOC contamination as separate tasks within the current MMR-IRP program.

3.5 BIOTIC COMMUNITIES

The Massachusetts Military Reservation (MMR) covers an area of approximately 20,000 acres. Eighty percent of MMR remains undeveloped and provides natural habitat for wildlife. The remaining 20% of MMR has been developed to support various military needs. No comprehensive ecological surveys of MMR have been carried out, therefore no comprehensive species list is available.

The forests on MMR that occur primarily in the range, impact, and maneuver area are classified as pine-oak climax forests. The predominant vegetation is pitch pine (Pinus rigida) and scrub oak (Qercus iliafolia). Other species include white oak (Quercus alba), red oak (Qercus borealis), and pin oak (Quercus palustrus). Understory vegetation includes bracken fern, sweet fern, common greenbriar, blueberry, and other heaths (Massachusetts ANG 1985). The cantonment and flight line consists of open, mowed grassland and lawns.

Common mammals found at MMR include the red fox, grey fox, raccoon, red squirrel, eastern chipmunk, woodchuck, skunk, shorttail weasel, rabbit, and whitetail deer. Birds that are common to MMR are ruffed grouse, bob white quail, chickadee, gold finch, herring gull, osprey, red tail hawk, bluejay, mockingbird, brown thrasher, and robin. There have been sightings of the short-eared owl during winter in some of the open fields (U.S. Army Corps of Engineers, 1985). Scientific names of these species are tabulated as Table 3.5-1. In addition, there are over 100 species of migratory birds that use the Cape as a major stop on the Atlantic Flyway. Because of the small area of aquatic habitat, MMR does not constitute a major waterfowl habitat.

Edmunds Pond and Osborne Pond support fish populations consisting of largemouth bass (Micropterus salmoides), chain pickerel (Esox niger), yellow perch (Perca flavescens), and brown bullhead (Ictalvrus nebulosis). Small

TABLE 3.4-5

SUMMARY OF ANALYTICAL RESULTS FROM OTIS ANGB MEDICAL SERVICE AND BARNSTABLE COUNTY SAMPLING EVENTS

Community	Date of Sampling Event	Number of Private Wells Sampled	Number of Private Wells with Total VOCs Detected in Following Concentrations			
			ND <1 μg/L	1-5 μg/L	6-50 μg/L	Greater than 50 μg/L
Ashumet Valley, Falmouth	August 1985	200	161	32	6	1
Briarwood, Mashpee	February- March 1986	8	5	0	3	0
Tri-Town Circle/ Horseshoe Bend Way, Mashpee	February- March 1986	28	25	3	0	0

Source: Barnstable County Health Dept. (1986)

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TABLE 3.5-1

COMMON FAUNA AT MMR

red fox	Volpes fulva
gray fox	Urocyon cinereoargenteus
raccoon	Procyon lotor
red squirrel	Tamiasciurus hudsonicus
eastern chipmunk	Tamias striatus
wood chuck	Marmota monax
skunk	Mephitus mephitus
shorttail weasel	Mustela erminea
cotton rabbit	Silvilagus floridanus
white tail deer	Odocoileus virginianus
ruffed grouse	Bonasa umbellus
bob white quail	Colinus virginianus
chickadee	Tarus atricatillus
gold finch	Spinus tristis
herring gull	Larus argentatus
osprey	Pandion haliaetus
red tail hawk	Buteo jamaicensis
blue jay	Cyanocitta cristata
mocking bird	Nimus polyglottos
brown thrasher	Toxo stomarufum
robin	Turdus migratorius

Source: Massachusetts Natural Heritage Program (1985)

populations of these fish may exist in some of the other permanent kettle ponds on the reservation.

Wildlife management at MMR consists of a deer hunting season administered each year by the Massachusetts Division of Fisheries and Wildlife. The hunting season is in November. A maximum of 600 permits are issued for any given day of hunting on the reservation. In the 1985 season a total of 53 deer were taken.

The Massachusetts Natural Heritage Program (MNHP) did an inventory of endangered and threatened wildlife at MMR in the summer of 1984. The results indicated that there are currently no known federal endangered or threatened wildlife species occurring on MMR. There are also currently no known state listed endangered or threatened species of mammals, reptiles, amphibians, fish, or invertebrates occurring on MMR (MNHP 1984).

Three species of birds that inhabit the unforested areas and fields around runways and taxiways have been classified by the Massachusetts Division of Fisheries and Wildlife as State Endangered, State Threatened, or Species of Special Concern. These are (1) the Upland Sandpiper (Bartramia longicauda), which is considered State Endangered; (2) Northern Harrier or Marsh Hawk (Circus cyaneus), which is considered State Threatened; (3) and the Grasshopper Sparrow (Ammodramus savannarum), which is considered a Species of Special Concern. Further study was conducted and a subsequent report was written by MNHP in 1985 in order to develop a management plan for maintaining or enhancing habitat for these three species that is compatible with primary National Guard responsibilities and objectives. This report is currently being reviewed by the National Guard.

The MNHP 1984 survey located two areas on MMR that support rare plants. The first area is the unnamed ponds in the Rod and Gun Club area just northeast of the Route 28 rotary near the main gate for MMR (see Figure 3.2-1). In those ponds Umbrella-grass (Guirena-pumila) and Hyssop Hedge-nettle (Stachys-hyssopifolia) were found. The other ponds that are located on MMR are floristically much less diverse than these ponds and contain no rare species (MNHP 1985). The second area is a roadside grassy habitat along Greenway Road, at the edge of the range area north of the Sandwich gate. Sandplain Flax (Linum intercursum) is found here and is listed as a state rare plant.

3.6 ENVIRONMENTAL SETTING SUMMARY

The MMR is situated on upper Cape Cod in the Coastal Plain province. The cantonment area lies on a broad flat, gently sloping outwash plain. The range, impact, and maneuver area and the areas to the west of MMR lie mainly on the hummocky, moraine terrain. Throughout the MMR, numerous Kettle holes dot the landscape. The reservation contains two named ponds and several other small water bodies. Surface water runoff is virtually nonexistent due to the high permeability of the soils and the relatively flat topography. In the southern portion of MMR intermittent streams or drainage swales exist. Flow may be initiated in the drainways during periods of heavy rainfall as a result of

discharge from the storm sewer system that drains the flight line area. The intermittant stream courses lead off-base toward Ashumet Pond and Johns Pond.

Surface water quality data are limited. Analysis of water from Osborne Pond has been limited to drinking water parameters. Of those analyzed none was above the Safe Drinking Water Standards or Class B by the Commonwealth of Massachusetts. Water quality in Ashument Pond, which is downstream and downgradient of the reservation, shows a trend toward eutrophication that results from impact of excess nitrogen and phosphorus. In addition, toluene and TCE have been detected in the waters of the cranberry bog located immediately north of Ashument Pond.

Soils on the MMR are a mixture of sandy to sandy-loam surface soil and subsoil with a substratum of sand and gravel. They are generally very well drained. In the moraine areas many large boulders are present. The soils are highly permeable and would be susceptible to infiltration by contaminants.

A designated sole source aquifer exists under unconfined conditions beneath the MMR. This aquifer occurs in the unconsolidated sand and gravel deposits. This sole source aquifer supplies the Upper Cape. By virtue of its location on the highest elevation of this system, MMR represents a major recharge area. Groundwater flows radially from MMR. The predominant flow direction from the cantonment area is to the south. The water table averages generally 50 ft below the surface beneath the cantonment area. Recharge to the aquifer is from precipitation and from inflow from adjacent zones of the aquifer. Discharge is to lakes and ponds, rivers, and to the ocean, in addition to utilization as potable water supply.

Groundwater quality at MMR has been closely monitored. Several wells show detectable concentrations of VOCs, predominantly the solvents PCE and TCE, and trihalomethanes were also detected but in much lesser concentrations on the reservation. In addition to solvents, oil and grease and other petroleum-related hydrocarbons were detected in several of the Otis ANGB, Phase II, Stage 1 IRP monitoring wells. Overall, the groundwater beneath MMR shows significant contamination. Because of the groundwater flow rate of 1 to 2 ft/d there is potential for the contamination to migrate off-base. Organic compounds have been identified to the south of MMR. The extent and sources of the on- and off-base groundwater contamination are currently under study as other components of the MMR IRP Program.

Average annual rainfall at MMR is approximately 48 in. and net precipitation (total rainfall minus evaporation and other losses) is 21 in. The 1-yr, 24-hr rainfall event is 2.7 in. The value of 21 in./yr for net precipitation indicates a significant potential for infiltration as well as surface runoff and the occurrence of permanent surface water features. The 1-yr, 24-hr rainfall event of 2.7 in. indicates a significant potential for runoff and erosion. These data indicate that contamination at MMR could migrate significantly by both surface water and groundwater pathways. The high permeability of the soils and the low topographic gradient greatly reduce potential for surface water contamination migrations.

Twenty percent of MMR consists of developed land, whereas the remaining 80% remains undeveloped and provides natural habitat for wildlife. Forests on MMR exist in the undeveloped areas and are classified as pine-oak climax forests. There are no perennial streams located on MMR. There are several small Kettle hole ponds and two larger ponds (Edmunds and Osborne Ponds). The two larger ponds support populations of warmwater species of fish. Wildlife management at MMR consists of a deer hunting season administered by the Massachusetts Division of Fisheries and Wildlife.

There are currently no known federal endangered or threatened wildlife species occurring on MMR. There are three species of birds that are classified as either State Endangered, State Threatened, or Species of Special Concern by the Massachusetts Division of Fisheries and Wildlife. There are also two areas on MMR that support rare plants.

As a result of the hydrogeological environment and soil characteristics, conditions at MMR are conducive for contaminant migration. Contaminants would primarily migrate vertically through the soils to the groundwater. Contaminant transport by surface water would be very limited due to the surficial permeability. Any contaminants entering the groundwater could potentially contaminant the sole source aquifer used by residents of Cape Cod as potable water.

4.0 FINDINGS

To assess hazardous waste management and disposal at the USCG facilities at MMR, past activities of material useage, waste generator, and disposal methods were reviewed. This section contains a summary of hazardous wastes generated, descriptions of waste disposal methods, identification of USCG waste disposal sites on base, and evaluation of the potential for environmental contamination. Section 4.1 provides a review of USCG activities that have potential for hazardous waste generation. Section 4.2 describes the USCG disposal sites identified on-base and presents an evaluation of the potential for environmental contamination.

4.1 CURRENT AND PAST ACTIVITY REVIEW

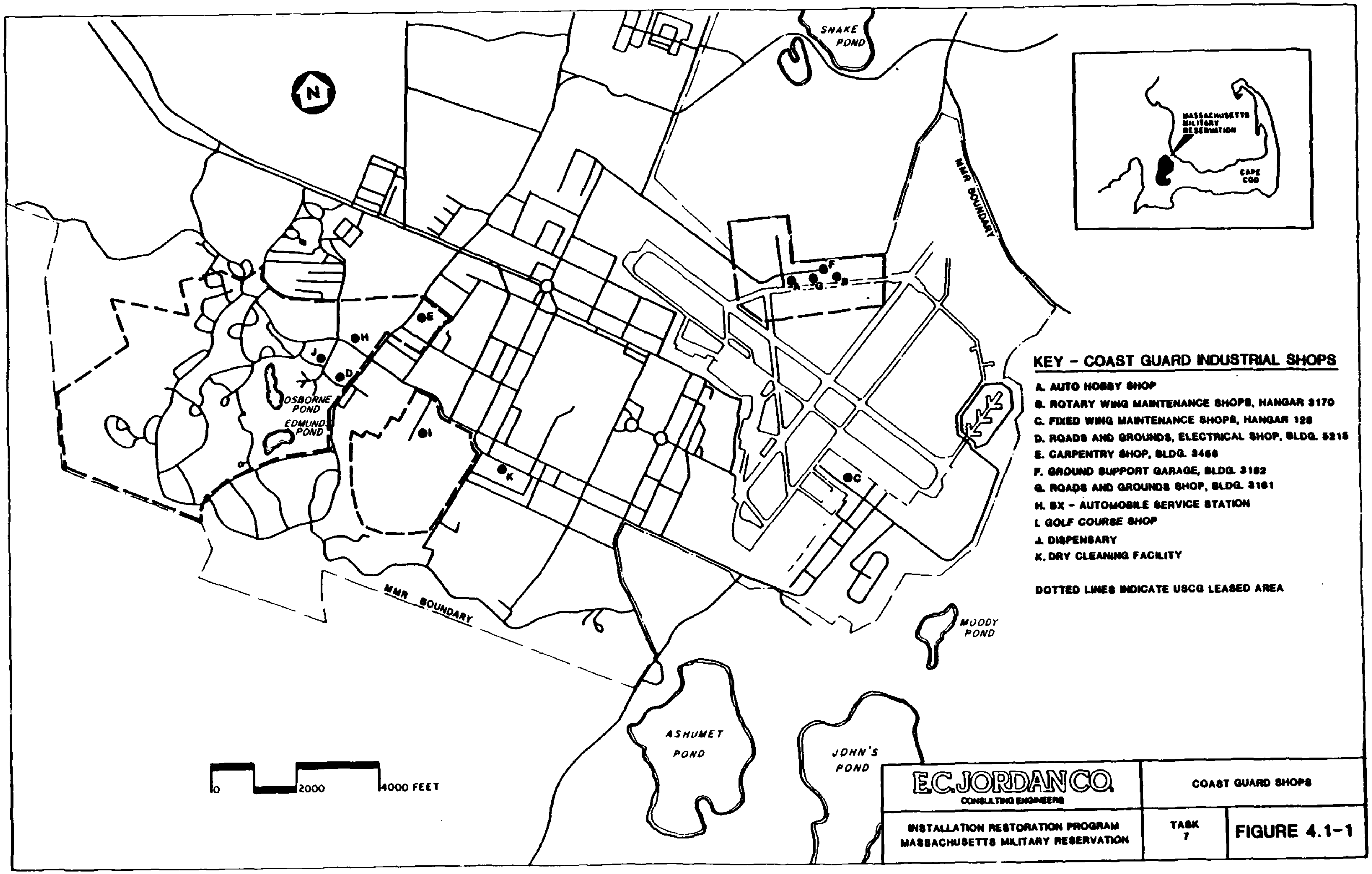
In an effort to identify possible hazardous waste disposal sites, current and past operation and disposal methods were reviewed. During this activity, files and records were reviewed, current and former base employees were interviewed, and possible disposal areas were inspected.

The Coast Guard Air Station Operations discussed in this section include those in which toxic or hazardous materials have been handled, stored, or disposed of. These activities include industrial operations in which pesticides; polychlorinated biphenyls (PCBs); POLs; and organic solvents have been handled.

The Air Station became fully operational on the base in 1970. During the period 1964 to 1970, operations were moved from the Air Station at Salem, Massachusetts. Since that time, industrial operations have remained essentially the same. Because historical levels of activity have remained essentially consistent with current levels, waste types, generation rates, and locations are assumed to be representative of historical activity.

Appendix D contains a list of shops operating at the Coast Air Station. Locations of the shops are shown in Figure 4.1-1. A summary of waste generation from industrial operations is presented in Table 4.1-1. Industrial, activities, and waste treatment, storage, and disposal are described in the following paragraphs. A comprehensive hazardous waste management survey of USCG industrial operations was performed in late 1983 by the Hazardous Materials Technical Center (HMTC 1984). This survey discusses industrial/hazardous waste handling, storage, and disposal.

As described in the following paragraphs, liquid and solid hazardous wastes generated by USCG activities are disposed of off-base. The current USCG hazardous waste disposal contractor is SYN-oil Co. In general, detailed records of quantities of waste materials generated have not been kept, and information contained in Table 4.1-1 was summarized from interview notes and the HMTC (1984) survey. Temporary storage of hazardous wastes prior to pickup either occurs in tank trailers (bowsers) located at individual shops or in a roped-off area of BLDG 3425. At the time of the site visit 6 55-gal barrels of waste solvents were stored in this area. No evidence of spills was present in the temporary storage area.



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CONSULTING ENGINEERS

COAST GUARD SHOPS

INSTALLATION RESTORATION PROGRAM
MASSACHUSETTS MILITARY RESERVATION

TASK 7

FIGURE 4.1-1

TABLE 4.1-1
MMR, USCG INDUSTRIAL OPERATIONS
WASTE GENERATION

Shop Name	Location (Bldg. No.)	Waste Materials	Waste Quantity (gal/yr)*	Waste Management Practices 1935	1945	1955	1965	1975	1985
I. Special Services									
A. Auto Hobby Shop	3160	Waste Oils	660						Contract Disposal
		CRC-226 Solvent (Petroleum distillate)	Variable						To RI. DRMO
		Antifreeze (ethylene glycol)	Variable						To RI. DRMO
B. Golf Course	3340	Pesticide Residuals	Variable						Contract Disposal
		Waste Oil	<20				Contract Disposal		
C. Dry Cleaning Facilty	1146	Tetrachloroethylene	Variable			(Unknown)ANG & USAF Control		Not in Service	One Time Disposal to DRMO
II. Rotary Wing Maintenance									
A. Avionics Shop	3170	Cleaning Solvents (trichlorofluoromethane, dichlorofluoromethane, 1,1,1-Trichloroethane, isopropyl alcohol, methylene chloride)	Variable			USAF Control 1960 - 1965	Evaporate in process empty containers to landfill		
		Polyuerethane foam (disphenylmethane diisocyanate, trichlorofluoromethane)	Variable			Aircraft Maintenance Nose docks located in Vicinity of Building 3170	Evaporate in process empty containers to landfill		
		Water displacing compound (CRC-226 1,1,1 trichloroethane)	Variable				Evaporate in process empty containers to landfill		
		Potassium hydroxide electrolyte solution	Unknown					To sanitary sewer	
		Spent Ni-Cad (Nickel/Cadmium) Battery Cases	Variable					Contract Disposal	

* Units for waste quantities are in gal/yr unless otherwise noted.

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TABLE 4.1-1

MASSACHUSETTS MILITARY RESERVATION
WASTE GENERATION

Shop Name	Location (Bldg. No.)	Waste Materials	Waste Quantity (gal/yr)*	Waste Management Practices					
				1935	1945	1955	1965	1975	1985
B. Survival Shop	3170	Adhesive, paints, and cleaning solvents (toluene, petroleum distillate, zinc chromate, methylene chloride)	Variable (<5)					Used or evaporated in process →	
C. Metal Shop	3170	Cleaning solvents, waste paints and thinners (MEK, toluene, xylene)	260					Contract Disposal →	
D. Engine Shop	3170	Cleaning solvent (PD-680) (Petroleum distillates)	120				On-site dumping and contract disposal	Contract disposal →	
		Waste oil and JP-4	200						
E. Helo Shop	3170	Cleaning solvent (PD-680) (Petroleum distillates)	150				On-site dumping and contract disposal	Contract disposal →	
		Waste Oil	80						

*Units for waste quantities in gal/yr unless otherwise noted.

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TABLE 4.1-1
MASSACHUSETTS MILITARY RESERVATION
WASTE GENERATION

Shop Name	Location (Bldg. No.)	Waste Materials	Waste Quantity (gal/yr)*	Waste Management Practices 1935	1945	1955	1965	1975	1985
III. Fixed-Wing Maintenance Division									
A. Avionics Shop	128	(Trichlorofluoromethane MEK, MIBK, methylene chloride toluene, xylene, petroleum petroleum distillate)	Variable				USAF Aircraft Maintenance	Vacant	Evaporation in process
		Waste Fuel	24				USAF Aircraft Maintenance	Vacant	Contract Disposal
		Waste Oil	660				USAF Aircraft Maintenance	Vacant	Contract Disposal
		Waste Solvents (MEK, acetone toluene, methanol)	275				USAF Aircraft Maintenance	Vacant	Contract Disposal
B. Survival Shop	128	Adhesives, paints, and cleaning solvents (Toluene petroleum distillate zinc chromate, methylene choloride)	Variable				USAF Aircraft Maintenance	Vacant	Evaporation in process
C. Metal Shop	128	Cleaning solvents, waste paints and thinners (MEK, toluene, xylene methylene chloride, 1,1,1-trichloroethylene petroleum distallates)	220				USAF Aircraft Maintenance	Vacant	Contract disposal
D. Propulsion Shop	128	Waste Fuel (JP-4)	24				USAF Aircraft Maintenance	Vacant	Contract disposal
		Waste Oil	660						
		Solvents (MEK, MIBK, acetone toluene, methanol, 1,1,1-trichloroethane)	275						

*Units for waste quantities in gal/yr unless otherwise noted.

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TABLE 4.1-1
MASSACHUSETTS MILITARY RESERVATION
WASTE GENERATION

Shop Name	Location (Bldg. No.)	Waste Materials	Waste Quantity (gal/yr)*	Waste Management Practices					
				1935	1945	1955	1965	1975	1985
IV. Facilities Engineering Department									
A. Roads and Ground Shop	5215/ 3161	Waste Oil	80					Contract disposal →	
		Hydraulic Fluid	6					Contract disposal →	
		Cleaning Solvent (1,1,1-Trichlorotheane, petroluem distillate)	Unknown					Contract disposal →	
B. Carpenter Shop	3456	Waste Turpentine	110					→	Contract disposal
		Waste Paints	Variable					→	Contract disposal
C. Electrical Shop	5215	Waste Contact Cleaners Lubricating Oil (1,1,1-Trichloroethane, petroleum distillates, dichlorofluoromethane trichlorofluoromethane)	1 (pint/yr)					Used or evaporated in processes →	
D. Ground Support Garage	3161	Waste Oil	660					Contract disposal →	
		Solvents (MEK, Tolnene benzene, xylene, petroleum distillate)	960					Contract disposal →	
		Battery Acid	Amount Unknown					Discharged to Drywell →	
		Used Batteries						Undrained batteries to scrap dealer →	

*Units for waste quantities in gal/yr unless otherwise noted.

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TABLE 4.1-1

MASSACHUSETTS MILITARY RESERVATION
WASTE GENERATION

Shop Name	Location (Bldg. No.)	Waste Materials	Waste Quantity (gal/yr)*	Waste Management Practices 1935–1985
V. Miscellaneous Shops/Activities				
A. Transmitter Station		Waste Solvents (trichloroethylene)	30	USAF Transmitter (c. 1955–1968); USCG Control (1968–1976): Dumped on ground
		Waste Oil	Unknown	Dumped in onsite drum (c. 1968–present); Contract disposal
B. BX-Automotive Service Station	5205	Waste Oil	1500	USAF Prior to USCG Control (c. 1952–1975); Contract disposal (1975–present)
C. Dispensary	5200	Waste Fixer	24	Discharged to sanitary sewer (c. 1970–present)
		Waste Developer	24	Discharged to sanitary sewer (c. 1970–present)
		Waste Solvents	Amount Unknown	Discharged to sanitary sewer (c. 1970–present)

*Units for waste quantities in gal/yr unless otherwise noted.

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4.1.1 Industrial Operations

4.1.1.1 Special Services

Auto Hobby Shop

The Auto Hobby shop has been located in building 3160 since 1980. Members of the USCG use the shop to maintain private vehicles. Currently, waste oil and solvent is collected in a bowser (tank trailer) and picked up for off-base disposal by an outside contractor. In the past, volumes of waste oil and solvent were likely small and may have been dumped on-site.

Golf Course

The MMR golf course was established in 1963 prior to USCG control. The clubhouse and storage building are located in buildings 5453 and 5454. In 1979 the Coast Guard started to use small quantities of fertilizer and EPA-registered pesticides on the course. These chemicals come in bags or plastic 1-gal containers and require no mixing. Empty pesticide containers are disposed of by an outside contractor. Maintenance of golf carts and lawn mowers are generally serviced in building 1532. Small amounts of waste oil are generated during maintenance. This oil is stored in a bowser and picked up by an outside contractor for disposal. No records exist prior to USCG control.

Dry Cleaning Facility

Two 55-gal drums containing Dowchlor® were present in BLDG 1146, the base launderette, at the time of the on-site record search. The drums were removed in February 1986 by the USCG and shipped to the Defense Reutilization and Marketing Office (DRMO).

The launderette has two coin-operated dry cleaning machines. These machines were using Dowchlor® as the dry cleaning compound, which is 96% PCE. Dowchlor® was used in the past as a dry cleaning compound but is no longer produced.

The drums of PCE were stored in a utility room located in the back of the building. They were positioned horizontally and were connected to the dry cleaning units by rubber hoses. Reportedly, during an inspection, a bucket acting as a catch basin was observed beneath one of the drums. According to others who used the facility, the dry cleaning machines periodically leaked fluid onto the floor in the laundry room. Fluids, possibly dry cleaning compound, were also observed on the floor of the utility room where the drums were kept. Leaking and spilled fluids are channeled into building floor drains, which empty into the sanitary sewer system.

The Coast Guard has been in control of this building and its operation since approximately 1975. Previously, the USAF and ANG operated the facility. Reportedly, the dry cleaning machines have not been operational since 1975. The machines are now locked and out of use.

4.1.1.2 Rotary-Wing Maintenance

Rotary-Wing Aircraft are repaired and maintained in Hangar 3170. The five shops located within the hangar include the avionics shop, the survival shop, the metal shop, the engine shop, and the Helo shop. Each shop has been operated by USCG since 1970 and is discussed in the paragraphs below. Prior to USCG construction of building 3170, USAF nose docks for maintenance of EC-121 aircraft were located on the present site of building 3170.

Avionics Shop

The Avionics Shop is responsible for the maintenance of electronics equipment. Small quantities of adhesives, solvents, and paints are used (<10 gal/yr). These materials evaporate or are used in process. Small quantities of waste occasionally are disposed of to the ANG landfill. Variable quantities of used nickel-cadmium batteries are discarded through an outside contract. Waste electrolyte is neutralized, diluted, and disposed of into the sanitary sewer.

Survival Shop

The Survival Shop repairs rescue flotation devices and dewatering pumps. Small quantities of adhesives and cleaning solvents are used in the shop. These materials are used up/or evaporated in the process.

Metal Shop

This shop is responsible for maintenance of wheels, brakes, cables, and hydraulics systems on aircraft. Wastes generated include 260 gal/yr of waste paints, thinners, and solvents. These wastes are generated during spray painting operations and are stored in a bowser and then picked up for disposal by an outside contractor.

Engine Shop

Wastes generated from engine repair include waste cleaning solvent (120 gal/yr) and waste oil (200 gal/yr). Prior to 1976, portions of these wastes were dumped behind the hangar for dust control. Currently, the wastes are picked up by an outside contractor.

Helo Shop

The Helo Shop repairs helicopter roto-heads. Wastes generated in the process include waste cleaning solvent (150 gal/yr) and waste oil (80 gal/yr). These wastes were handled in the same manner as those from the engine shop.

4.1.1.3 Fixed-Wing Maintenance

Fixed Wing aircraft have been maintained in hangar 128 since 1976. Four shops are located within the hangar; they include the avionics, survival, metal, and propulsion shops. Wastes generated from activities in these shops include waste fuels (24 gal/yr); waste oil (660 gal/yr); aerosols, paints, strippers, and adhesives (220 gal/yr); and waste solvents (275 gal/yr). These wastes are

picked up for disposal by an outside contractor. Some minor spills of waste fuels and solvents have reportedly occurred.

Periodic small (<5 to 10 gal) aviation gasoline (AVGAS) spills occurred within the hangar prior to 1983 as a result of expansion of fuel in HU-16 aircraft tanks. This occurred as a result of heating of the aircraft from active steam lines located under the hangar ducts. In 1978 two significant quantities of AVGAS were spilled outside of the hangar. One spill of 200 to 300 gal occurred and one spill of 600 to 800 gal occurred as a result of aircraft fueling operations. AVGAS spills were washed to the storm water drainage system.

Prior to 1970, the USAF maintained fighter aircraft in hangar 128. No detailed records are available for activities occurring in this hangar. However, spent petroleum distillate solvents, chlorinated solvents, and waste oils would have been generated. In accordance with practices ongoing on the Otis-AFB flight line at that time, it is assumed that the majority of these wastes would have been discharged to the storm water drainage system or taken to the base landfill.

The following paragraphs describe the activities in each hangar 128 shop.

Avionics Shop

The shop is responsible for the maintenance of electronic equipment. Small amounts of adhesives, solvents, and paints are generated. These wastes evaporate in the process of being used.

Survival Shop

The Survival shop repairs flotation devices and dewatering pumps. Small quantities of adhesives and cleaning solvents are used within the shop. These wastes are evaporated within the process.

Metal Shop

The Metal shop is responsible for the maintenance of wheels, brakes, cables, and hydraulic fluid lines in aircraft. Waste cleaning solvents, paints, and oils are generated during these activities. These wastes are stored in a bowser and then picked up by an outside contractor for disposal. For an unknown period, solvents were reportedly discharged to the sanitary sewer.

Propulsion Shop

The Propulsion shop is responsible for engine repair. During this operation, cleaning solvents, oils, and paint waste are generated. These wastes are disposed of in a bowser, which is emptied by an outside contractor.

4.1.1.4 Facilities Engineering Department

Roads and Grounds Shops

Since 1970 the Roads and Grounds shops have been located in buildings 5215 and 3161. These shops are responsible for the maintenance of roads and grounds at the air station. Both shops do minor maintenance on equipment; major maintenance is handled by the Ground support garage. Waste oil (80 gal/yr), hydraulic fluid (60 gal/yr), and cleaning solvent (unknown quantity) are generated during shop operation. These wastes are picked up for disposal by an outside contractor. In the past, minor spills of solvents and oil have reportedly been washed to the street to enter the storm water drainage system. Prior to USCG occupation of these two facilities, they were used for nonindustrial operations. Building 5215 was used as an Noncommissioned Officer-Enlisted Man (NCO-EM) Club. Building 3161 was used by NCO-EM the USAF for materials and organizational supply.

Carpentry Shop

The Carpentry shop has been located in building 3456 since 1973. From 1973 to 1982, the shop handled only the housing area. Since 1982 the shop has been responsible for the entire air station. Wastes generated include turpentine (110 gal/yr) and latex paint residues (variable quantities). These wastes are picked up for disposal by an outside contractor.

Electrical Shop

The Electrical shop, located in building 5215 since 1976, maintains and installs electrical equipment for the air station. Chemicals used include cleaning solvents and lubricating oils. These materials are used up or evaporate during use. The USCG electrical shop is not involved in the maintenance of base electrical power. This function is carried out by the ANG and is described in a separate Phase I report.

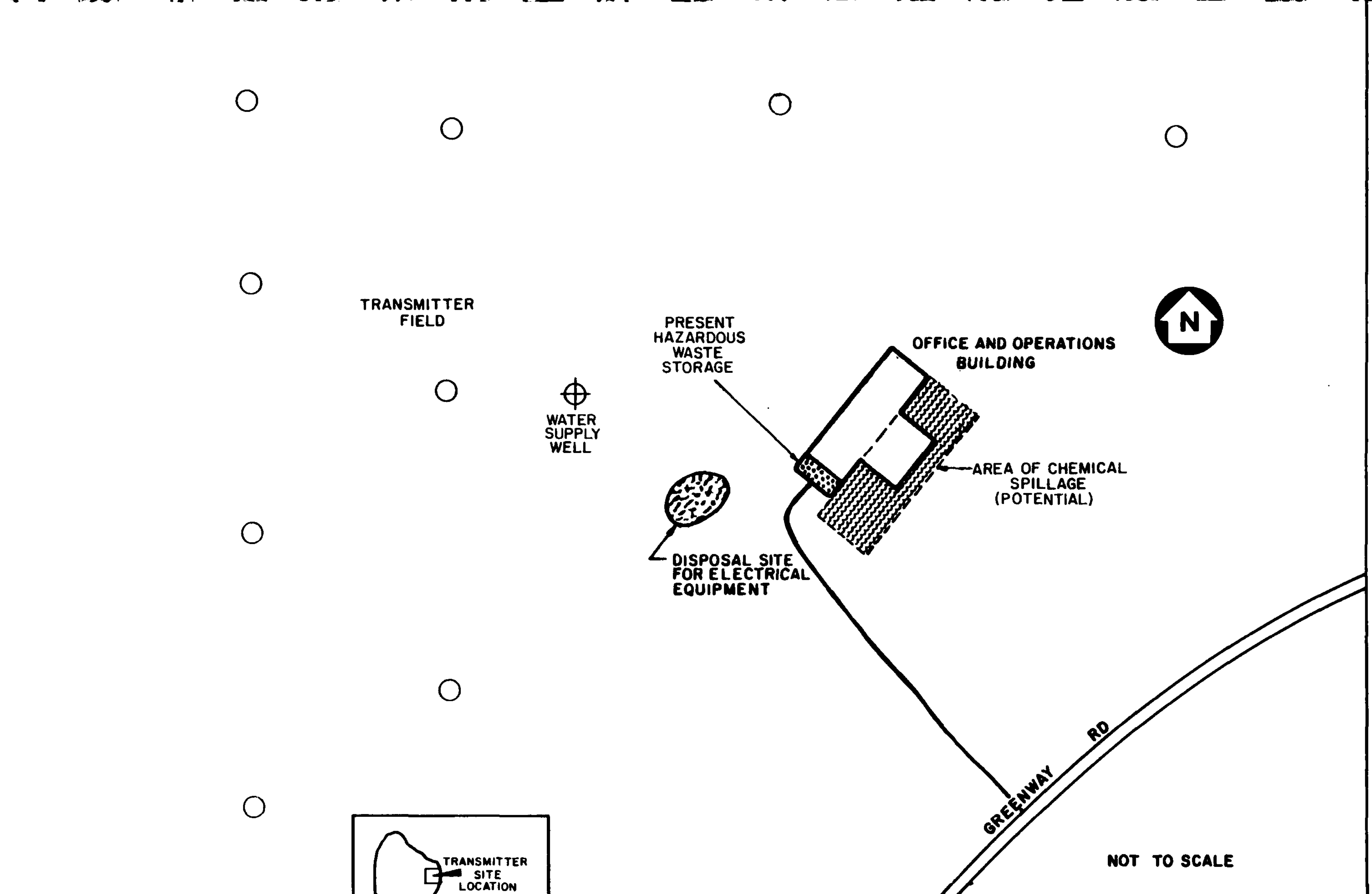
Ground Support Garage

The Ground support garage has been located in building 3162 since 1970. The garage is responsible for maintenance of all gasoline and diesel powered vehicles owned by the Air Station. Wastes generated include waste oil (660 gal/yr), solvents (960 gal/yr), and battery acid (unknown quantity). Waste oil and solvents are picked up for disposal by an outside contractor. Until at least 1981, battery acid was dumped into a drywell on site; now it is left in the batteries, which are sold to a local scrap dealer.

4.1.1.5 Miscellaneous Shops/Activities

Transmitter Station

The Coast Guard has operated a Transmitter Station located in the eastern range area of MMR since 1969. From 1961 to 1969 the area was occupied by a USAF transmitter. No records of waste types or disposal methods are available for the USAF operations. The general location of the transmitter station is shown in Figure 4.1-2. From 1969 to 1975 the station reportedly used 300 gal/yr of



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MASSACHUSETTS MILITARY RESERVATION

TASK 7

FIGURE 4.1-2

solvents, including TCE. These waste solvents were reportedly dumped on the ground at the site until 1975. Contamination of a water supply well at the transmitter site caused abandonment of the well. The nature of this contamination and the exact location of this well is unknown. A second well installed at the site contains trace levels of 1,1,1-TCA (see Section 3.4.2). Waste oil is currently generated on the site. This oil is stored in a 55 gal drum; spillage may have occurred in the vicinity of this drum. The drum is emptied by an outside contractor. As indicated in Section 4.1.4, the potential exists at the site for burial of several capacitors and transformers and 15 to 30 gallons of transformer oil. The layout of present facilities and most likely disposal locations are shown in Figure 4.1-2.

BX Automobile Service Station

The BX Automobile Service Station has been located in building 5205 since 1951. The station has been operated by the Coast Guard since 1970. Prior to 1970, the facility was operated by the USAF. Until 1979, the shop provided vehicle repair service. During this time, about 1500 gal/yr of waste oil was generated and stored in an underground tank on-site. In 1985 this tank was tested and found to be leaking. The tank and 18 cu yds of contaminated soil were removed. Currently, another underground tank on-site serves as a used oil receptacle for base residents. This tank is emptied by a private contractor.

4.1.2 Laboratory Operations

With the exception of the dispensary, no laboratory operations are located at the Coast Guard Air Station located on Cape Cod.

The medical dispensary has been located in building 5200 since 1970 (see Figure 4.1-1). Photographic developer (24 gal/yr), fixer (24 gal/yr), and small amounts of solvents are generated on-site. Silver is reclaimed and sold. Fixer, developer, and solvents are discharged to the sanitary sewer (see Table 4.1-1).

4.1.3 Pesticide Handling, Storage, and Disposal

Pesticide application at the USCG facilities has been carried out by an outside contract. No storage handling or disposal of pesticides is carried out by USCG with the following exceptions. Pesticide for home use (insect spray, etc.) is provided in the Base Exchange, and limited quantities of herbicides and pesticides are used at the golf course. This latter activity was described in Section 4.1.1.1.

4.1.4 PCB Handling, Storage, and Disposal

Reportedly, several potentially PCB containing capacitors were buried at the USCG transmitter station (see Figure 4.1-2). Location and verification of the PCB status of this equipment are not documented. Reportedly approximately 15 to 30 gal of transformer/capacitor fluid were spilled on the ground in the area around the building.

4.1.5 POL Handling, Storage, and Disposal

The types of POL used and stored at the Coast Guard facility at MMR include motor gasoline (MOGAS), Jet Aircraft fuel (JP-4), kerosene, fuel oil, and diesel fuel. In the past, until 1983, AVGAS was supplied to fuel HU-16 aircraft. USCG POL storage tanks are listed in Table 4.1-2. Current spill management and waste disposal for the Coast Guard is addressed in Spill Prevention and Control Plan written in 1985 (U.S. Coast Guard 1985).

The ANG supplies the fuel to the Coast Guard as needed. There are four 5,000 gal refuelers that the Coast Guard uses to fuel up aircraft. These tankers obtain their fuel (JP-4) from the ANG Petrol Fuel Storage Facility. Diesel fuel and MOGAS are delivered by the ANG to underground tanks located at Hangar 128, BLDG 5215, and BLDG 3162. This fuel is used for ground support equipment and also to fuel the refuelers.

The Coast Guard utilizes 45 vehicles for its daily operations. Thirty eight of those vehicles are leased from the U.S. Government. Fuel for these 38 vehicles is bought off-base at commercial gasoline stations. The remaining six vehicles are Department of Transportation (DOT) vehicles, which utilize the pumps at Hangar 128.

The Coast Guard is responsible for the operation and maintenance of a commercial gasoline station located on MMR. This station is supplied by a commercial fuel distributor.

Waste POL was collected in a bowser at each building as described in Section 4.1. Until 1983, the contents were taken to a 10,000-gal underground storage tank located at the Defense Property Disposal Office (DPDO) on West Truck Road for contract disposal. Waste POL was also used for dust control. From 1972-1977 waste oil was dumped behind the air station hangar (BLDG 3170) approximately twice each summer to control dust. Currently, all waste oil is stored in a bowser and is picked up by an authorized handler.

From 1953-1983 waste oils generated at the service station were stored in a 1,000-gal underground tank until removed by a private contractor. In 1985 this tank was tested and was determined to have a leak. It was removed and a total of 18 cu yd of contaminated soil was removed and disposed off-base under a hazardous waste disposal contract. Waste oil is currently stored in a 1,000-gal aboveground tank.

4.1.6 Radioactive Materials Handling, Storage, and Disposal

No radioactive materials have reportedly been used at the Air Station.

4.1.7 Explosive/Reactive Materials Handling, Storage, and Disposal

The only reactive materials handled by USCG consist of signal flares, which are stored in the Pyrotechnics Locker, BLDG 3158. Out of date pyrotechnics are disposed of through the explosive ordinance demolition (EOD) operation. MMR EOD activities are described in a separate Phase I report produced as a component of the MMR IRP.

TABLE 4.1-2

POL STORAGE FACILITIES
COAST GUARD

Tank Location	Capacity (gals)	Aboveground AG Underground UG	Former Contents	Current Contents	Date Installed	Date Leak Tested	Tank Owner/ Operator	Future Plans
Current Product Tanks								
Bldg. 128	500	UG	--	Diesel	1979	--	USCG	Diesel
Bldg. 128	500	UG	--	MOGAS	1979	--	USCG	MOGAS
Bldg. 3159	500	UG	--	Fuel Oil	1979	--	USCG	Fuel Oil
Bldg. 3161	275	AG	--	Diesel	1955	--	USCG	Diesel
Bldg. 3162	500	UG	--	MOGAS	1955	--	USCG	MOGAS
Bldg. 3170	500	UG	--	Diesel	1970	--	USCG	Diesel
Bldg. 3170	8000	UG	--	Fuel Oil	1970	--	USCG	Fuel Oil
Bldg. 3170	30000	UG	--	Water	1970	--	USCG	Water
Bldg. 3170	30000	UG	--	Water	1970	--	USCG	Water
Bldg. 5202	10000	UG	--	MOGAS	1960	--	USCG	MOGAS
Bldg. 5202	10000	UG	--	MOGAS	1960	--	USCG	MOGAS
Bldg. 5202	6800	UG	--	MOGAS	1960	--	USCG	MOGAS
Bldg. 5202	10000	UG	--	Fuel Oil	1960	--	USCG	Fuel Oil
Bldg. 5204	4000	UG	--	Fuel Oil	1954	--	USCG	Fuel Oil
Bldg. 5215	2000	UG	--	MOGAS	1979	--	USCG	MOGAS
Bldg. 5215	275	AG	--	MOGAS	1979	--	USCG	MOGAS
Bldg. 5215	275	AG	--	Diesel	1979	--	USCG	Diesel
Bldg. 5200	500	AG	--	Diesel	1958	--	USCG	Diesel
Bldg. 128	60	AG	--	Kerosene	1980	--	USCG	Kerosene
Abandoned Tanks								
Bldg. 3161	500	UG	Diesel	Empty	1966	--	USCG	Remove
Bldg. 5202	500	UG	Waste Oil	Empty	1960	1984	USCG	Remove

NOTE

All Coast Guard tanks were identified as steel tanks.

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4.2 WASTE DISPOSAL METHODS AND DISPOSAL SITES: IDENTIFICATION, EVALUATION, AND HAZARD ASSESSMENT

As described in the current and past activity review (Section 4.1), various methods have been used for disposal of wastes generated by USCG activities. In general operations wastes have included halogenated solvents, petroleum distillate solvents, waste POL (combined with solvents), lead-acid and Ni-Cad (nickel-cadmium) batteries, and spent electrolyte generated as a result of aircraft and vehicle maintenance and electronics parts cleaning. The majority of these liquid organic wastes have been contained and disposed of off-base by a hazardous waste contractor. Wastes also have been disposed to the base landfill. The MMR sanitary landfill has been evaluated as a component of previous Phase I and Phase II programs (Metcalf and Eddy, 1983; Weston 1985) and the ongoing MMR-IRP (Phase II). Discussion of the MMR sanitary landfill is contained in a separate Phase I report within the MMR IRP program.

Spent electrolyte from battery disposal is discharged to the sanitary sewer system or to a dry well. The base STP discussed in a separate Phase I report is being evaluated as a component of Phase II activities within the MMR IRP program.

Disposal sites located on USCG facilities at MMR are described, and their potential for environmental contamination and contamination migration is evaluated in the following paragraphs.

4.2.1 Storm water Drainage System

There are several storm water drainage areas on USCG property at MMR. The majority of runoff is from the road system and housing areas. These areas of runoff discharge do not represent significant potential for environmental contamination.

Storm water runoff from the housing area is discharged at several points to Osborne Pond, to the area around Edmunds Pond, and to local surface depressions. These discharge areas also receive runoff from the Facilities Engineering Area. The potential hazard from these areas would be chloride contamination from road salt. Limited water quality data from Osborne Pond indicate that chloride contamination is not present.

Storm water runoff at the air station facility Hangar 3170 is negligible. There is a drainage ditch that runs parallel to the taxiway. Most storm water percolates into the ground before it can flow in the ditch. Disposal of wastes from the Hangar 3170 shops is described in Section 4.2-2.

The storm water runoff from the area around Hangar 128 is discharged into the open drainage basin located off of Reily Road. This basin is located on ARNG and ANG property and is described in a separate Phase I report within the MMR IRP. The potential for environmental contamination from Hangar 128 shops is evaluated in Section 4.2.3.

4.2.2 Landfills

The USCG does not operate its own landfill. Wastes generated are discarded at the ANG landfill or go to contract disposal. Three debris and rubble landfills were identified on land presently under USCG control. These are shown in Figure 4.2-1.

Landfill No. 1 (LF-1)

Landfill No. 1 (LF-1), located at the Coast Guard (CG) Air Station was used as a dump site for concrete and asphalt debris during the runway extension project. No evidence of hazardous waste disposal at this site was found, nor are there any reports of hazardous waste being dumped there. Therefore, no potential for contamination or contaminant migration exists, and LF-1 was eliminated from further consideration by means of the decision tree process described in Section 1.3.

Landfill No. 2 (LF-2)

Landfill No. 2 (LF-2), located north of present BX service station, is another rubble and debris disposal area. Concrete blocks were dumped here. No evidence of hazardous waste was found or reported to have been dumped here, thus the site did not pass the decision tree process for further evaluation. The former asphalt hot mix plant is located adjacent to the rubble disposal area. This area is evaluated in Section 4.2.4.

Landfill No. 3 (LF-3)

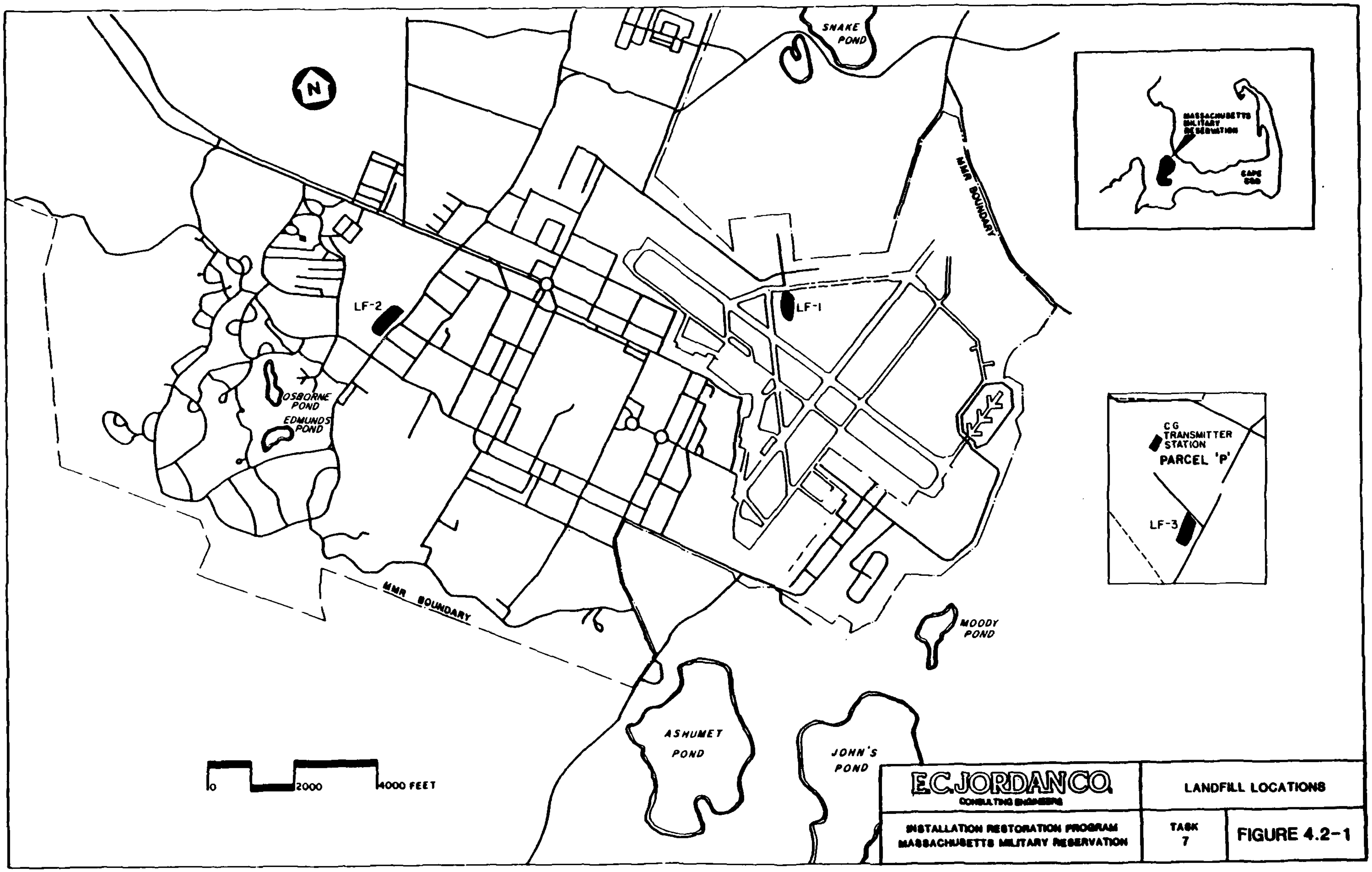
Landfill No. 3 (LF-3), located just south of the entrance to the CG Transmitter Station, is a rubble and debris landfill. At present, sand and gravel excavated from the construction of the new dispensary building is brought here. A site reconnaissance and interview of personnel did not reveal any hazardous waste disposal. Therefore, this site was eliminated via the decision tree process.

4.2.3 Chemical Spill and Disposal Sites

Seven locations on the USCG facilities can be classified as chemical spill and disposal sites. These are located adjacent to industrial activities that generate hazardous wastes and disposed portions of these materials on-site. Specific information regarding the time frame of disposal and quantities was discussed in Section 4.1. Evaluation of these sites is described in the paragraphs below. The location of these sites is shown in Figure 4.2-2. Disposal practices of each of the sites are summarized in Table 4.2-1.

Transmitter Station (CS-1)

The USCG transmitter station occupies 224 acres in the eastern portion of the range areas and has been operated by the Coast Guard since 1969. Prior to use by the Coast Guard the site was operated by the USAF. Currently, disposal of materials in the range area is prohibited, and waste solvents or oils are collected and disposed through the USCG hazardous waste program. During the



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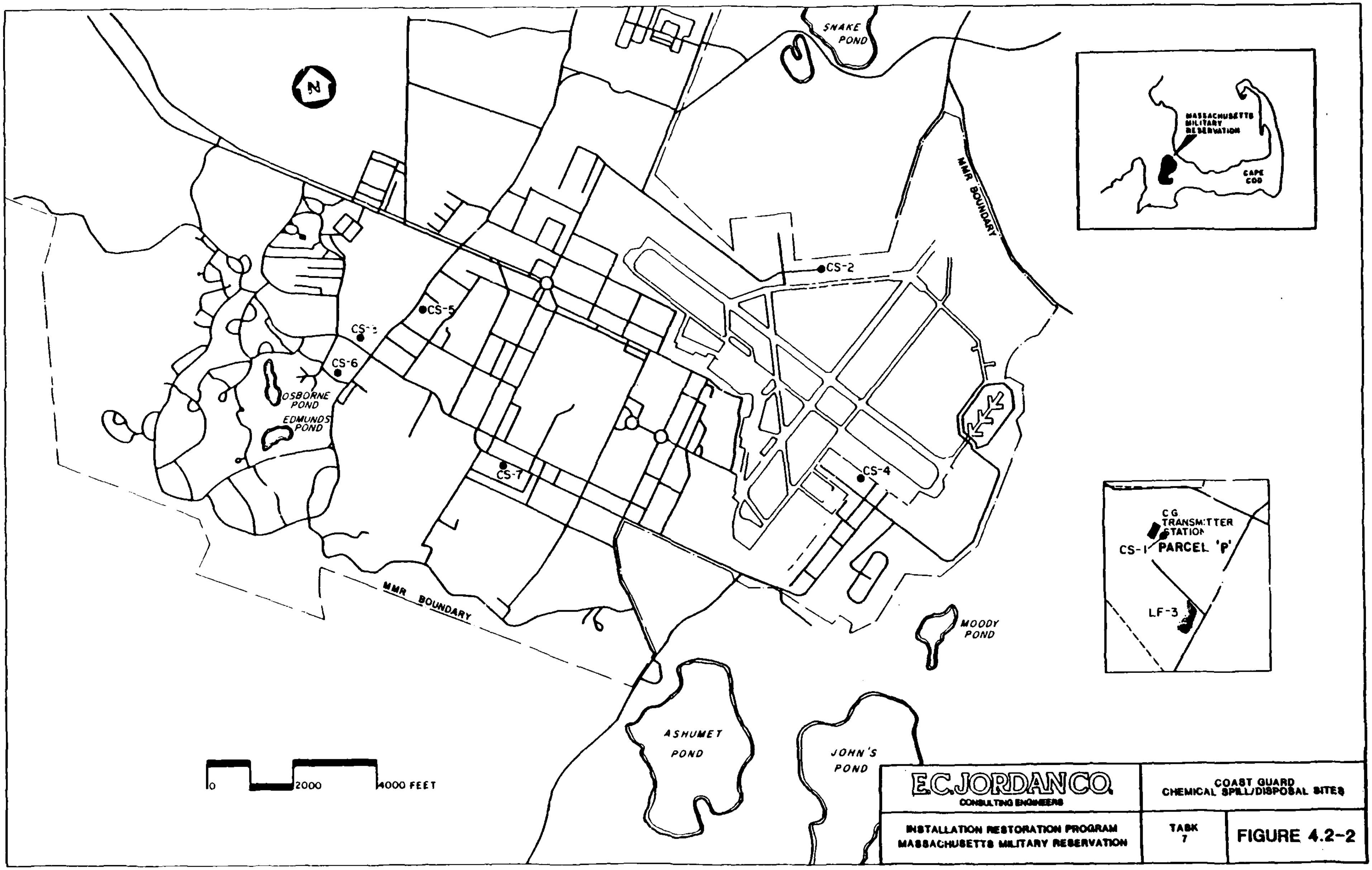
LANDFILL LOCATIONS

TASK 7

FIGURE 4.2-1



E.C. JORDAN CO. CONSULTING ENGINEERS	COAST GUARD CHEMICAL SPILL/DISPOSAL SITES	
INSTALLATION RESTORATION PROGRAM MASSACHUSETTS MILITARY RESERVATION	TASK 7	FIGURE 4.2-2

TABLE 4.2-1

SUMMARY OF CHEMICAL DISPOSAL SITES

Site Description	Site Designation	Probable Dates of Disposal	Waste Description
Transmitter Station	CS-1	1969-1975	Waste Solvents (TCE), Buried Capacitors, Transformers, Transformer Oil, and Waste Oil.
Hangar 3170 Area	CS-2	1972-1976	Waste Oil and solvents
		1970-1985	Neutralized Electrolytes
BX Automobile Service Station	CS-3	1951-1985	Waste Oil
Hangar #128	CS-4	1976-Present	Waste Fuels and Solvents
Carpentry Shop BLDG 3245	CS-5	1973-Present	Turpentine/ Latex Paints
Other Maintenance Shops	CS-6	1973-Present	Waste Oil and solvents
Dry Cleaning Facility	CS-7	1960s-1975	PCE

period 1969-1975, waste solvents, reportedly primarily TCE, and 15 to 30 gal of transformer oil were disposed of on the ground to the east of the transmitter building. Depending upon spill rates, weather conditions, and chemical properties, some of the waste solvents would be expected to volatilize. Small quantities of waste oil were also disposed of on-site. Due to the chemical properties of oils, waste oil spills would not be expected to volatilize. The locations of these disposal areas are shown in Figure 4.1-2. Solvents were also stored at this site in drums. The location of the disposal area has been covered by an addition to the transmitter facility. In addition to the solvent and oil disposal, it was reported that used electrical components, including capacitors and possibly transformers, were buried at the transmitter site. The transformer oil and the capacitors/transformers may contain PCBs.

CS-1 is located adjacent to the MMR boundary. Soils are highly permeable, and the MMR is a major recharge location for the Upper Cape. Surface water bodies (Weeks Pond and Snake Pond) are located within 1 mile of CS-1. These ponds receive groundwater input. The transmitter personnel utilize groundwater at this location as a potable water supply. The off-base population in this area also is served by private wells. As described in Section 3.4-2, traces of VOCs (1,1,1-TCA) have been observed in the transmitter station well. A former well at the transmitter station was abandoned because of contamination of an unknown nature. Evidence of contamination and contaminant migration exist, and therefore CS-1 was ranked using the HARM process (see Appendix G). The transmitter well is being sampled as a component of ongoing MMR IRP Phase II efforts. Conclusions and recommendations regarding this site are presented in Sections 5.0 and 6.0.

Hangar 3170 Area (CS-2)

The air station hangar 3170 area (CS-2) includes the Ground Support Garage, the Rotary-Wing maintenance shops, and the Auto hobby shops. This area was the site of chemical disposal on the ground from 1970 to 1981. Since 1981 the majority of waste liquids have been stored for contract disposal. The chemicals dumped at the site include waste oils, cleaning solvents, and used battery electrolytes. Stained ground was noted at the drums storage area on-site. During the period 1970-1976, aircraft washing occurred outside the hangar using petroleum distillate degreasing agents. This material was washed into storm drains and off the edge of the pad onto the ground. Currently, aircraft washing is done using a methanol/water mixture. From 1972-1976 waste POL combined with degreasing solvents as well as waste solvents (halogenated and nonhalogenated) were periodically dumped behind the hangar for dust control. Prior to 1970, a nosedock hangar for maintenance of EC-121 aircraft (Super-Constellations) was located in the vicinity of Hangar 3170. The level of that former activity is not documented. Hangar 3170 was constructed for use by USCG aircraft. Floor drains within Hangar 3170 discharge to a drainage ditch outside of the building. These drains are discharged through an oil water separator. Waste lead-acid battery electrolyte and Ni-Cad electrolyte were discharged to these drains along with spilled oil and solvents from the hangar floor for the period 1970-1985. Potential exists for contamination as a result of spills and disposal to provide dust control and as a result of floor drainage. Contaminants disposed of at building 3170 include metals from spent electrolyte, POL compounds, and halogenated and nonhalogenated solvents. Depending upon weather conditions, spill rates, and chemical properties, some

of these contaminants would be expected to volatilize. However, as a result of the permeable soils, potential for contaminant migration exists. MMR is located in a recharge area, and the BLDG 3170 area is located near the installation boundary. CS-2 was therefore ranked using the HARM process (see Appendix G). Conclusions and recommendations regarding this site are presented in Sections 5.0 and 6.0.

BX-Automobile Service Station (CS-3)

The BX-Automobile service station has provided service for privately owned vehicles of the residents of the MMR since 1951. Up until 1979, the station provided full automobile repair services. All waste oils collected from the work were deposited in a 1,000-gallon underground storage tank. Approximately 1,500-gal/yr of waste oil was removed from the tank by a private contractor and disposed of off-site.

In 1985 the tank was tested to see if it was suitable for use as a receptacle for waste oil generated by installation housing occupants. The tank could not be pressurized for testing and was scheduled for removal. The soil beneath the tank was saturated with oil and was excavated to a depth of 3 ft below the last evidence of stained soil. Approximately 18 cu yd of soil was removed and disposed of off-site.

The quantities of waste oil leaking from the tanks during the period of use are unknown but are considered to be small because of the relatively small quantity of stained soil. Waste POL would contain oil-related aromatic organic compounds (toluene, benzene, xylenes) and aliphatic hydrocarbons. Persistence of these in the subsurface environment of MMR is not known. Combined with the waste oil would be halogenated and nonhalogenated solvents, as well as lead and other metals from engine components. As a result of the observation of oil-stained soil, evidence exists for release and therefore potential for environmental contamination. Because of the permeable nature of the soils at MMR, contaminant migration potential exists. CS-3 was therefore ranked using the HARM process (see Appendix G). Conclusions and recommendations regarding this site are presented in Sections 5.0 and 6.0.

Hangar 128 Area (CS-4)

Hangar 128 is operated by the USCG for maintenance of fixed-wing aircraft. The hangar, however, is located on the ANG portion of MMR. From 1955-1970, hangar 128 was used for maintenance of the EC-121 (Super-Constellation) aircraft. This activity is described as a component of a separate Phase I Report within the MMR IRP program. The Hangar 128 shops have generated waste oil as well as halogenated and nonhalogenated solvents since 1970. Solvents and waste oil have been spilled periodically within the hangar and outside. The hangar deck has open floor joints, therefore spilled materials can migrate to the subsurface. Waste oils and solvents were stored in a bowser outside of the hangar. Reportedly, approximately 25% of the wastes were spilled onto the ground. Depending upon spill rates, weather conditions, and chemical properties, some of the solvents spilled would be expected to volatilize. Other solvents and waste oils would infiltrate soils. Fuel spills also have occurred at Hangar 128. These are discussed in Section 4.2.4. Potential contamination exists at

Hangar 128 as a result of waste POL and solvent discharged to the land surface and subsurface as a result of USCG operations and past USAF operations. Because of the permeable nature of the soils at MMR, potential for contaminant migration exists at Hangar 128. Site CS-4 was therefore rated using the HARM process (see Appendix G). Conclusions and recommendations regarding this site are presented in Sections 5.0 and 6.0.

The Carpentry Shop (CS-5)

The carpentry shop, located at BLDG 3456, has been in operation since 1973. Turpentine is used to clean brushes and rollers used in latex paint application. Small quantities of paint and turpentine are spilled in transfer to 55-gal drums of waste thinner. Since turpentine is readily biodegradable and small spill quantities are involved, no significant potential is considered to exist for contamination. This site therefore was removed from further consideration through the decision tree process described in Section 1.3 (see Figure 1.3-1).

Maintenance Shops (CS-6)

Maintenance shops located in BLDG 5215 include the electrical shop, utility shop, roads and grounds shop, and the general "do it now" shop. These shops have been operated by the Coast Guard since 1973. Wastes generated include waste POL, hydraulic fluid, and solvents. These wastes are primarily generated in the roads and grounds shop. Spills of waste have occurred. The potential for contamination exists at CS-6. Depending upon spill rates, weather conditions, and chemical properties, some of the solvents would be expected to volatilize. However, because the soils at MMR are highly permeable, potential for migration exists. This site was, therefore, evaluated using the HARM process (see Appendix G). Conclusions and recommendations regarding CS-6 are presented in Sections 5.0 and 6.0.

Dry Cleaning Facility (CS-7)

The dry cleaning facility located in BLDG 1146 was in operation from the mid-1960s to 1975. Prior to 1975 it was under USAF and ANG control. Reportedly, since 1975 the dry cleaning machines have been nonoperational.

Two 55-gal drums containing Dowchlor® were present in BLDG 1146, the base launderette, at the time of the on-site record search. The drums were removed in February 1986 by the USCG and shipped to the DMRO.

The launderette has two coin-operated dry cleaning machines. These machines were using Dowchlor® as the dry cleaning compound, which is 96% PCE. Dowchlor® was used in the past as a dry cleaning compound but is no longer produced.

The drums of PCE were stored in a utility room located in the back of the building. They were positioned horizontally and were connected to the dry cleaning units by rubber hoses. Reportedly, during an inspection, a bucket acting as a catch basin was observed beneath one of the drums. According to others who used the facility, the dry cleaning machines periodically leaked fluid onto the floor in the laundry room. Fluids, possibly dry cleaning

compound, were also observed on the floor of the utility room where the drums were kept. Leaking and spilled fluids are channeled into building floor drains, which empty into the sanitary sewer system.

The Coast Guard has been in control of this building and its operation since approximately 1975. Previously, the USAF and ANG operated the facility. Reportedly, the dry cleaning machines have not been operational since 1975. The machines are now locked and out of use.

Because of the potential for past leakage and spills, site CS-7 was considered to have potential for contamination and for contaminant migration as a result of PCE wastes entering the sanitary sewer system. Potential for contaminant migration of PCE from the Dry Cleaning facility via the sanitary sewer system has been considered in the assessment and recommendations regarding the MMR Sewage Treatment Plant (Site CS-16 in the Task 6 Phase I Report). Virtually no potential exists for spills outside the dry cleaning facility, therefore, this site has been dropped from further consideration and rating. The site has been referred to MMR environmental programs to verify that the sewer line at this location does not leak significantly.

4.2.4 Fuel Spill Sites

Hangar 128 Fuel Spills (FS-1)

There are two locations in which known major spills (>100 gal) took place. In 1978 there was an AVGAS spill of between 200 to 300 gal behind Hangar 128. The spill was on pavement and was washed off onto the surrounding soil. In 1978 there was also an AVGAS spill of 1,000 gal on the tarmack besides Hangar 128. This spill was washed into a storm drain. Descriptions of activities and operations concerning fuel handling at the USCG facilities are described in Section 4.1.5.

The spill washed into the storm drain would have flowed to the nearest storm sewer outfall. The storm drainage at MMR has been evaluated as a component of a separate Phase I report within the current MMR IRP program. The 200 to 300 gal spill washed into the ground would be expected to leave little residual organic content because of volatilization. In a single spill incident such as this, the soil would absorb the spill initially. A certain component would volatilize, and the remainder would be carried down into the vadose zone by infiltrating water. The vadose zone at the Hangar 128 area of MMR is estimated to be 40 to 50 ft thick. Even given the low sorptive capacity of MMR soils it is likely that a very small spill would be irreversibly sorbed and not migrate to the water table. Because it appears that little or no potential for migration is present, this fuel spill was eliminated from further consideration in the decision tree process. Lead associated with the 300-gal AVGAS spill would be a small quantity, <1 lb (100/g), and therefore does not represent significant contamination.

Hot Mix Asphalt Plant (FS-2)

From 1941-1943 there was a Hot Mix Plant located along Turpentine Road, which is property now leased by the CG. The hot mix plant was operated by a private

contractor. Trucks that transported the hot mix to various locations were washed out with kerosene or diesel fuel prior to being refilled. It is estimated that approximately 8,000 gal of kerosene or diesel have been spilled in this area during its period of operation.

Kerosene contains aromatic and aliphatic organic compounds. In a situation such as the one at FS-2 where kerosene or diesel was spilled on the ground over a period of several years, a considerable portion of the fuel would be degraded by bacteria, contingent on there being sufficient nutrients, particularly nitrogen, to provide an adequate C:N ratio for growth. Soils at MMR appear to be low in nutrients, therefore potential biodegration would not be strongly promoted. A considerable portion of the fuel would volatilize; however, this amount depends on the spill rate, surface conditions, and weather at the time of the spill. The remainder would partition between the soil and infiltrating water. The extent to which MMR soils would hold POL is not documented, however the soils are low in organic content. This would promote migration. It is probable that after 43 yrs the fuel at FS-2 would have disappeared from the site. However, using the HARM process, aromatic and aliphatic hydrocarbons are considered persistent. Therefore, potential exists for contamination and contaminant migration, and FS-2 was rated using the HARM process (see Appendix G). Conclusions and recommendations regarding this site are presented in Sections 5.0 and 6.0.

4.2.5 Hazard Assessment Evaluation

The review of past operation and maintenance functions and past waste management practices at USCG/Facilities at MMR has resulted in the identification of 12 sites that were initially considered areas of concern with potential for contamination and migration of contaminants. These sites, described in Sections 4.2.1 through 4.2.4, were evaluated using the decision process presented in Figure 1.3-1 (in Section 1.3). Six sites found to have no potential for contamination were deleted from further consideration. One of these sites (CS-7) was found to warrant review of operational procedures and modification under the Station Environmental Program. The 1984 Hazardous Waste Management Survey (HMTC 1984) indicated the requirements to develop a comprehensive hazardous waste management plan, to file appropriate Massachusetts and Federal Notification documentation, and to modify/document disposal practices. Upgrading of disposal practices and recordkeeping are being implemented.

Six sites found to have potential for contamination and migration of contaminants by the decision process are described in Section 1.3. The decision process logic used for each area of initial concern is presented in Table 4.2-2. The sites found to have potential for contamination or contaminant migration were evaluated using the HARM system. The HARM system includes consideration of potential receptor characteristics and waste management practices. The details of the rating procedures are presented in Appendix G; results of the assessment are summarized in Table 4.2-3.

The HARM system is designed to indicate the relative need for remedial action. The information presented in Table 4.2-3 is intended for assigning priorities for further evaluation of the USCG disposal areas (Section 5.0--Conclusions and

Table 4.2-2.
SUMMARY OF DECISION PROCESS LOGIC FOR AREAS OF INITIAL ENVIRONMENTAL CONCERN AT USCG FACILITIES ON MMR

Site	Designation	Potential for Contamination	Potential for Contaminant Migration	Potential for Other Environmental Concern	Refer to Base Environmental Programs for Future Action	HARM Rating
Landfill No. 1	LF-1	No	No	No	No	No
Landfill No. 2	LF-2	No	No	No	No	No
Landfill No. 3	LF-3	No	No	No	No	No
Chemical Disposal Site No. 1	CS-1	Yes	Yes	No	No	Yes
Chemical Disposal Site No. 2	CS-2	Yes	Yes	No	No	Yes
Chemical Disposal Site No. 3	CS-3	Yes	Yes	No	No	Yes
Chemical Disposal Site No. 4	CS-4	Yes	Yes	No	No	Yes
Chemical Disposal Site No. 5	CS-5	No	No	No	No	No
Chemical Disposal Site No. 6	CS-6	Yes	Yes	No	No	Yes
Chemical Disposal Site No. 7	CS-7	Yes	No††	No	Yes	No
Fuel Spill Site No. 1	FS-1	No	No	No	No	No
Fuel Spill Site No. 2	FS-2	Yes	Yes	No	No	Yes

* Refer to Figure 1.3-1 for the decision process.
† Other environmental concerns include environmental problems that are not within the scope of this study (e.g., air pollution, occupation safety problems.)
**NA = Not applicable.
††As described in text, contaminant migration would have been to the STP via the sanitary sewer line. PCE contamination from this site has been addressed as a component of the Task 6 Phase I Report.

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Table 4.2-3.
SUMMARY OF HARM SCORES FOR POTENTIAL CONTAMINATION SOURCES AT USCG FACILITIES ON MMR

Site No.	Site	Report Designation	Receptor Subscore	Waste Characteristics Subscore	Pathway Subscore	Waste Management Factor	Overall Total Score
1	Transmitter Station	CS-1	75.6	80	43.8	1.0	68.5
2	Hangar 3170 Area	CS-2	83.3	70.0	46.2	1.0	66.5
3	BX Automobile	CS-3	74.4	60.0	51.2	0.95	58.7
4	Service Station Hangar 128	CS-4	72.2	36.0	53.7	1.0	54.0
5	USCG Maintenance Shops	CS-6	77.7	40.0	53.7	1.0	57.1
6	Asphalt Hot Mix Plant	FS-2	72.0	56.0	51.0	1.0	59.7

Section 6.0--Recommendations). The rating forms for the individual waste disposal sites are presented in Appendix H.

5.0 CONCLUSIONS

The goal of the IRP Phase I study is to identify sites where there is potential for environmental contamination resulting from past waste disposal practices and to assess the potential for contamination migration from these sites. The conclusions are based on the evaluation of information collected from the project team's field inspection; review of records and files; examination of historical aerial photographs; and interviews with base personnel, past employees, and state and local government employees. Twelve potential contamination sources were identified on USCG facilities at MMR. The evaluation of these sites are identified, and their evaluation is summarized in Table 5.0-1. Locations of these sites are shown in Figures 5.0-1 and 5.0-2. Six of the 12 sites were determined to have a potential for contamination and/or contaminant migration. Evaluations and conclusions regarding the seven sites (CS-1, CS-2, CS-3, CS-4, CS-6, and FS-2) that have a potential for contaminant migration and received HARM scores are detailed in the following paragraphs. HARM methodology is presented in Appendix G; individual HARM rating forms for each site are presented in Appendix H.

5.1 CHEMICAL SPILL/DISPOSAL SITE CS-1: USCG TRANSMITTER SITE (HARM SCORE - 68.5)

As described in Section 4.2.3, approximately 30 gal/yr of waste solvents along with small quantities of waste POL were dumped on the ground at this location during the period 1969-1975 within 100 yds of the transmitter water supply well. The original transmitter well was abandoned because of contamination of an unknown nature. A second well established to replace the contaminated well located at the transmitter station was found to contain traces of 1,1,1-TCA, a halogenated solvent, in 1985. In addition to documented groundwater contamination, it was reported that scrapped electrical equipment, including capacitors and transformers, were buried in a trench at the transmitter site. Reportedly also, 15 to 30 gal of transformer oil was disposed of on the east side of the building. The transmitter is located adjacent to the eastern MMR boundary. Regional groundwater movement at this location appears to be toward the east or southeast, indicating potential for contamination migration off-base.

The transmitter site is located at the eastern boundary of MMR. As a result of observed contamination of the transmitter supply well and the probable groundwater flow direction to the east, potential for off-base migration of contaminants exists.

This site received a HARM rating of 68.5.

5.2 CHEMICAL SPILL/DISPOSAL SITE CS-2 HANGAR 3170 AREA (HARM SCORE - 66.5)

As described in Section 4.2.3, the shops operating in the Hangar 3170 area include the Rotary-Wing Maintenance areas, the Ground Support Garage, and the Auto Hobby Shop. During the period 1972-1976, waste POL, and solvents, were

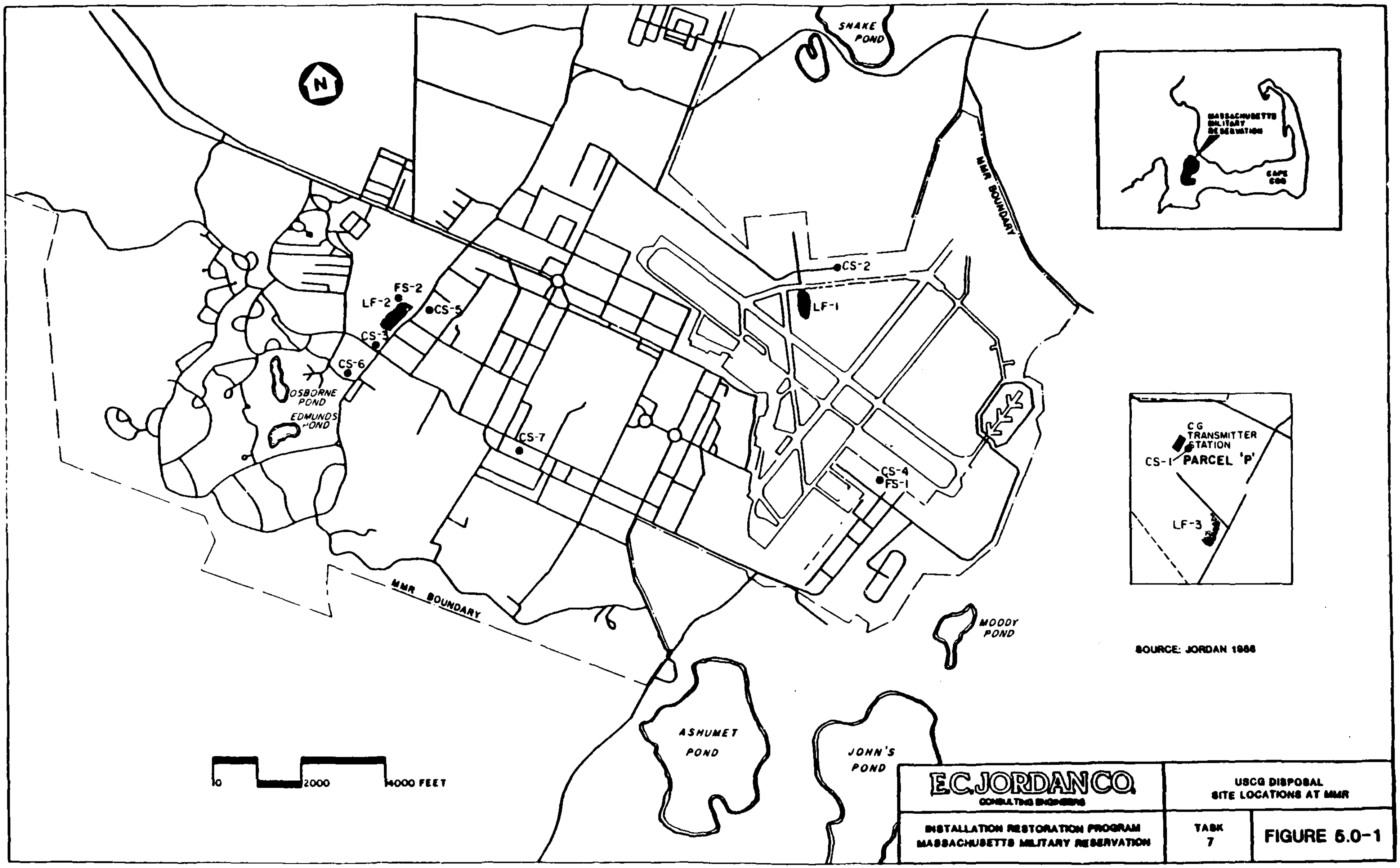
TABLE 5.0-1
SUMMARY OF POTENTIAL CONTAMINATION AT USCG FACILITIES
ON MMR

Report Designation	Site Description and Location Figure	Date of Operation or Occurrence	Conclusions
LF-1	Rubble/Debris Landfill No. 1 (Figure 5.0-1)	1950s	Concrete and asphalt debris from runway extension. No potential for contamination. No recommended Phase II activities.
LF-2	Rubble/Debris Landfill No. 2 (Figure 5.0-1)	Unknown	Concrete rubble disposed into low area. No evidence of contamination. No HARM rating. No recommended Phase II activities.
LF-3	Rubble/Debris Landfill No. 3 (Figure 5.0-1/ 5.0-2)	1985-Present	Rubble/debris landfill currently receiving inert wastes from dispensary construction. No potential for contamination. No HARM rating. No recommended Phase II activities.
CS-1	USCG Transmitter Site (Figure 5.0-2)	1969-1975 USCG 1961-1969 USAF	Waste POL and solvents disposed onto ground. Possible buried capacitors, transformers, and transformer oil. Received a HARM rating of 68.5. Phase II studies recommended.
CS-2	Hangar 3170 Areas (Figure 5.0-1)	1970-1985	Disposal on the ground. Waste POL, solvents, and battery electrolytes. Received a HARM rating of 66.5. Phase II studies recommended.
CS-3	BX Automobile Service Station (Figure 5.0-1)	USCG 1970-1985 USAF 1955-1970 (Aircraft Maintenance)	Waste POL leaking underground tanks. Visible contamination removed. Received a HARM rating of 58.7. Limited Phase II studies recommended.
CS-4	Hangar 128 Area (Figure 5.0-1)	USCG 1976-Present USAF 1955-1970 (Aircraft Maintenance)	Waste POL and solvents spilled on ground and onto hangar deck, which has open floor joints. Received a HARM rating of 54.0. Limited Phase II studies recommended.
CS-5	Carpentry Shop (Figure 5.0-1)	1973-Present	Spills of turpentine and latex paint. No potential for residual contamination. No HARM rating. No recommended Phase II activities.
CS-6	Other USCG Maintenance Shops (Figure 5.0-1)	1973-Present	Spill of waste POL and solvents. Received a HARM rating of 57.1. Limited Phase II studies recommended.

TABLE 5.0-1

SUMMARY OF POTENTIAL CONTAMINATION AT USCG FACILITIES ON MMR

Report Designation	Site Description and Location Figure	Date of Operation or Occurrence	Conclusions
CS-7	Dry Cleaning Facilities (Figure 5.0-1)	1960s-1975	Possible spills and disposal of PCE into the sanitary sewer system. Contaminant migration is via the sanitary sewer system to the MMR sewage treatment plant. No HARM rating. No Phase II studies recommended. Phase II studies for the MMR Sewage Treatment Plant were recommended as a component of the Task 6 Phase I Report.
FS-1	Hangar 128 Fuel Spills (Figure 5.0-1)	1978	AVGAS spills. One 1,000-gal spill washed to storm sewer. Storm drainage at MMR is evaluated in a separate Phase I report. One 200 to 300 gal spill washed onto ground. No potential for contaminant migration. No HARM rating. No Phase II studies recommended.
FS-2	Hot-Mix Asphalt Plant (Figure 5.0-1)	1941-1943	Estimated 8,000 gal kerosene used to clean equipment disposed of to land surface. Received a HARM rating of 59.7. Because of the long period of time since the disposal occurred, Phase II studies are recommended only if residual hydrocarbons are found in more recent (1950s-1960s) disposals of JP-4 AVGAS and MOGAS.



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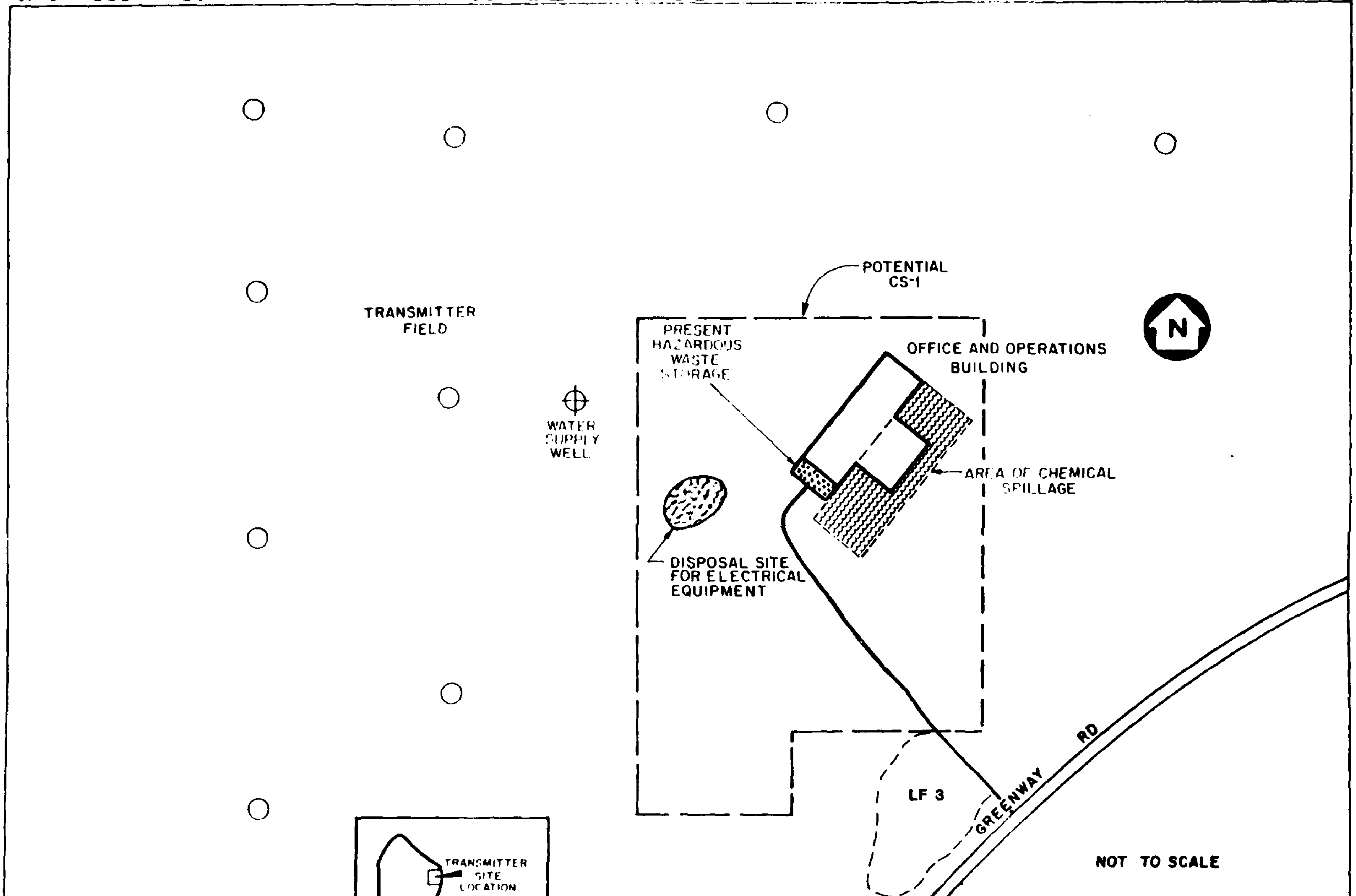
USCG DISPOSAL
SITE LOCATIONS AT MMR

TASK
7

FIGURE 5.0-1

APPENDIX A
GLOSSARY OF TERMINOLOGY, ABBREVIATIONS, AND ACRONYMS



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USCG TRANSMITTER FACILITY
DISPOSAL SITES

TASK
7

FIGURE 5.0-2

disposed of onto the ground for dust control or via spills. From 1970-1981 limited spills of solvents and waste oils were washed to the ditch outside via floor drains. From 1970 to 1985 neutralized diluted electrolytes were discharged to the drainage ditch outside via floor drains.

Soils at this location are permeable, and the potential exists for infiltration of contaminants to the water table. The 3170 area is located approximately 1200 ft east of Well J. At present, Well J is the sole water supply source for MMR. As described in Section 3.4.2, the zone of capture at Well J is estimated as 1000 ft radially. Trace concentrations of VOCs have been observed periodically in Well J. Ongoing Phase II studies at MMR suggest that groundwater flow direction at this location is southward, possibly into the zone of capture of wells (see Figure 3.3-5).

Potential exists for contamination and contaminant migration into groundwater from the Hangar 3170 area. The sources of contamination and potential future contamination of Well J are being addressed as a component of ongoing MMR Phase II and Phase IV-A IRPs. The extent of residual contamination and/or potential of the Hangar 3170 area to contribute to Well J recharge has not been determined at present.

This site received a HARM rating of 66.5.

5.3 CHEMICAL SPILL/DISPOSAL SITE CS-3: THE BX AUTOMOBILE SERVICE STATION (HARM SCORE - 58.7)

The BX Automobile service station has been operating at location CS-3 since 1951. Until 1979, automobile servicing and light maintenance was performed at this location. Waste POL from this activity was generated at a rate of 1500 gal/yr and stored in an underground tank for off-base disposal. In 1985, this tank was tested and was found to be leaking. The tank and all visible contaminated soil was removed. No soil testing was performed to verify that all contamination was removed. Waste POL typically is combined with solvents, metals from engine wear, and other organic compounds resulting from the degradation of the oil in engine use.

Because of the permeability of the soils at this location and evidence that small quantities of waste POL leaked into the subsurface, potential exists for contaminant migration from this location. The BX Automobile service station is located approximately 2000 ft northeast of base water supply Well G and 2400 feet northwest of former base supply Well B. Groundwater flow direction at the location of site CS-3 appears to be southward. In the past any contaminants from the BX-Service station may, therefore, have been drawn into the cone of influence of Well G. Because of the small quantity of stained soil observed, however, quantities of contaminants introduced to the subsurface are expected to have been small.

This site received a HARM rating of 58.7.

5.4 CHEMICAL SPILL/DISPOSAL SITE CS-4: THE HANGAR 128 AREA (HARM SCORE - 54.0)

As described in Section 4.2.3, fixed-wing aircraft have been maintained at this location since 1976. Hangar 128 is located on the flight line area under ANG

control. From 1976 to 1983 these included piston engine and jet aircraft. Prior to 1970 (1955-1970) Hangar 128 was operated as an aircraft maintenance area for USAF EC-121 piston engine aircraft. Aircraft maintenance facilities are being expanded in the Hangar 3170 area, and USCG use of Hangar 128 is scheduled to be phased out.

During USCG aircraft maintenance in Hangar 128, waste POL and solvents, as well as small (<5 gal/spill) quantities of AVGAS, were spilled on the Hangar Deck, which has open floor joints and into floor drains. Subsurface contamination therefore probably occurred. Solvents and waste POL also were disposed into the storm drainage system. The storm drainage system is evaluated in a separate Phase I report generated as a component of the ongoing MMR-IRP.

Because of the permeable nature of the subsurface, potential exists for contamination migration via groundwater at this site. Groundwater flow direction at this location is southward under the flight line area.

It is likely that a vadose zone up to 50 ft thick lies between the hangar deck and the water table. Infiltration probably is limited to floor washing activities. This could mitigate potential for contaminants recharging the water table. The capacity of the subsurface environment at MMR to bind organic contaminants and/or degrade them is not documented but may be limited by nutrient levels and organic content.

This site received a HARM score of 54.0.

5.5 CHEMICAL SPILL/DISPOSAL SITE CS-6: USCG MAINTENANCE AREA (HARM SCORE - 57.1)

As described in Section 4.2.3, Maintenance shops located in BLDG 5215 include the Electrical Shop, Utility shop, Roads and Grounds shop, and "do it now" shop. These shops have been operated by the Coast Guard since 1973. Wastes generated include waste oils, hydraulic fluid, and cleaning solvents. These wastes are primarily generated by the Roads and Grounds shops. Spills of these fluids onto the ground and into the street have occurred. Also, some of these shops were operated by the USAF prior to USCG occupancy. During this time, waste may also have been dumped. Because of the permeable nature of the soils at this location, contaminant transport is likely primarily via groundwater. Two former base water supply wells are located apparently downgradient of site CS-6. As described in the previous paragraphs, the presence of a deep vadose zone may mitigate the potential for migration from this site, however, soil conditions and contaminant fate/transport are not fully documented at MMR.

Because of the permeability of the subsurface and the presence of potentially useable groundwater supplies downgradient, this site received a HARM rating of 57.1.

Phase II and Phase IV-A studies are ongoing in the MMR IRP to identify the present and future contaminant sources to the base water supply wells.

5.6 FUEL-SPILL SITE FS-2: FORMER HOT-MIX ASPHALT PLANT (HARM SCORE - 59.7)

The former hot mix area (FS-2) is located along Turpentine Road. This site was used by Roach Construction Inc., from 1941-1943 as an area to clean out trucks that had been carrying tar to various locations on the reservation. The truck beds were washed out with kerosene or diesel fuel. It has been estimated that at least 8,000 gal of kerosene and diesel fuel were spilled at this site during cleaning operations.

Kerosene and diesel fuel contain aromatic and aliphatic hydrocarbons. Because of the perodic nature of the disposal and the long period since the cessation of operations, it is probable that much of the material volatilized or was degraded microbiologically. The soils at this location however are nutrient poor, low in organic content, and highly permeable. As discussed in Section 4.2.4, the quantities that may have migrated rather than undergoing transformation/volatilization are unknown. The potential for residual contamination in the vadose zone also is unknown. At FS-2 a deep vadose zone probably exists as for most of the cantonment area. The HARM ranking model considers both aromatic and aliphatic hydrocarbons as persistent in the environment. Potential residual contamination and contaminant migration southward via groundwater exist.

This site received a HARM rating of 59.7. Because of the age of the disposal, however, it is likely that minimal residual contamination remains under the specific environmental conditions at MMR.

6.0 RECOMMENDATIONS

6.1 PHASE II, STAGE 1 MONITORING RECOMMENDATIONS

Seven sites were identified on the USCG facilities at MMR as having potential for environmental contamination, and these sites have been evaluated using the HARM system. The relative potential of these sites for environmental contamination and contamination migration was assessed. Recommendations for Phase II Stage 1 verification study and monitoring were summarized in Table 5.0-1. Rationale for the recommendations is presented in this section. Phase II Stage 1 and 2 studies are ongoing at MMR as well as Phase IV-A as other components of the current IRP. Recommendations for Phase II studies at the six USCG sites consider data being gathered as a part of these programs.

The intent of the HARM system is to identify potential for contamination, it is expected that not all sites ranked and selected for Phase II study will show contamination during the verification program. As applied to the Phase I studies at MMR, the HARM constitutes an extremely conservative approach to site evaluation. This is because of three environmental factors specific to MMR. First, MMR is a major recharge area for a designated sole source aquifer. As a result the receptors subscores for all sites are high compared with most installations. Second, the unconsolidated surface substrate is extremely permeable. Minimal surface water transport occurs, but groundwater movement is rapid. The pathways subscore is, therefore, also relatively high, although this score is mitigated partially due to the presence of a thick vadose zone (approximately 50 ft in the cantonment area). Third, the HARM lists POL-related aliphatic and aromatic hydrocarbons as persistent. The length of time that these compounds, as well as halogenated solvents, persist after a spill or disposal may be much shorter at MMR than most areas because the soils are very low in organic content and may not retard migration. Under these environmental conditions the HARM may overrate the chemical characteristics subscore by overrating persistence. The low soil organic content and probable low levels of nitrogen and phosphorus, however, would tend to reduce the capacity or rate for microbiological degradation or transformation.

Because of these environmental conditions some sites at MMR may receive high HARM scores when residual contamination is no longer present. This is especially likely where the disposal or spill occured relatively long ago. Contaminants at such sites may have migrated into the groundwater or deep into the vadose zone. Generalized groundwater contamination at MMR may exist as a result of contaminants that have migrated from sources that no longer exist.

Because of the above factors the recommended Phase II Stage 1 studies are generally focused on verifying whether a residual contaminant source exists at sites identified in this Phase I program. Groundwater contamination already is documented at MMR. Overall characterization of contamination of groundwater and consequent contaminant control strategies focused on receptors are ongoing as components of existing Phase II and Phase IV-A studies. Phase II Stage 1 studies are not recommended for site FS-2 because of the age of the disposal (1941-1943) unless studies of other similar POL spill sites in which disposals are more recent indicate residual POL contamination. At one site (CS-1),

documented groundwater contamination exists. Because of this site's location at the MMR boundary and its remotness from the focus of ongoing Phase II activity, groundwater monitoring is proposed for Phase II, Stage 1 in addition to source verification.

Groundwater contamination has been documented at MMR. However, the multiplicity of potential disposal sites, the complexity of the timing of disposals, the rapid rate of groundwater movement, and the pumping history of the MMR water supply wells has resulted in a subsurface environment where groundwater monitoring has limited potential for attributing contamination to any specific source. Because of this, groundwater monitoring at MMR has been primarily receptor-oriented. Groundwater contamination may partially result from sources from which contaminants have migrated and because of the environmental conditions and age of the disposal, no residual contamination exists at the source or the residual contamination has infiltrated deep into the vadose zone.

Phase II, Stage 1 study recommendations, therefore, are focused primarily on verification that residual contamination exists at a specific disposal site. This is done by a program of shallow soil borings, test pit excavation, and deeper soil borings (to sample intervals representing the complete vadose zone), which are adequate to determine the nature of any residual contamination at each site. The geological program is coupled with field measurements of parameters such as pH and conductivity, borehole air monitoring, and with field gas chromatographic analysis. This is similar to the program currently being implemented. Geophysical (geoelectrical) methods that are generally useful in contamination exploration have been found to be compromised on MMR because of the various electronic signals resulting from MMR flight and communication operations.

The limited recommended Phase II studies category is recommended for sites where only a few samples or testing are required, such as at underground tanks suspected of leaking.

Well construction and sampling methodology and analytical technologies should be identical to those performed in other parts of the ongoing Phase II IRP at MMR to provide consistency. Analytical methods to be used for soil and groundwater should be identical to those used in ongoing Phase II activities using the Contract Laboratory Program. These are described in the MMR Quality Assurance Program Plan (QAPP).

6.2 RECOMMENDED GUIDELINES FOR LAND USE

It is desirable to have temporary land use restrictions for the identified disposal sites for the following reasons: (1) to provide the continued protection of human health, welfare, and the environment; (2) to limit the potential for migration of potential contaminants through improper land uses; (3) to facilitate the development of future facilities in a manner that will prevent contaminant migration; and (4) to allow for identification of property that may be proposed for excess or outlease.

The recommended guidelines for temporary land use restriction at the six identified potential disposal sites are presented in Table 6.2-1. Land use restrictions at individual sites should be re-evaluated upon completion of the Phase II monitoring program. Changes should be made where appropriate, based on the findings and based on any remedial action plan development.

TABLE 6.2-1

DESCRIPTION OF GUIDELINES FOR LAND USE RESTRICTIONS

Guideline	Description
Construction on the site	Restrict the construction of structures that make permanent (or semipermanent) and exclusive use of a portion of the site's surface.
Excavation	Restrict the disturbance of the cover or subsurface materials.
Well construction on or near the site	Restrict the placement of any wells (except for monitoring purposes) on or within a reasonably safe distance of the site. This distance will vary from site to site, based on prevailing soil conditions and groundwater flow.
Agricultural use	Restrict the use of the site for agricultural purposes to prevent food chain contamination.
Silvicultural use	Restrict the use of the site for silvicultural uses (root structures could disturb cover or subsurface materials).
Water infiltration	Restrict water runon, ponding, and/or irrigation of the site. Water infiltration could produce contaminated leachate.
Recreational use	Restrict the use of the site for recreational purposes (see page 6-11).
Burning or ignition sources	Restrict any and all unnecessary sources of ignition because of the possible presence of flammable compounds.
Disposal operation	Restrict the use of the site for waste disposal operation, whether above or below ground.
Vehicular traffic	Restrict the passage of unnecessary vehicular traffic on the site because of the presence of explosive material(s) and/or of an unstable surface.
Material storage	Restrict the storage of any and all liquid or solid materials on the site.
Housing on or near the site	Restrict the use of housing structures on or within a reasonably safe distance of the site.

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ADC	Aerospace Defense Command
AEHA	Army Environmental Hygiene Agency
AFS	Air Force Station
aliphatic	Hydrocarbon compounds with carbon bonds that are not arranged in a resonating ring structure
ANG	Air National Guard
ANGB	Air National Guard Base
anisotropic	Having physical properties, such as transmissivity, that vary in different directions
aquifer	A geologic formation, group of formations, or part of a formation capable of yielding water to a well or spring
ARNG	Army National Guard
aromatic	Hydrocarbon compounds in which carbon atoms are bonded in a resonating ring structure
ASCC	Air Station Cape Cod
AVCO	AVCO, Inc. A corporation based in Greenwich, Connecticut that engages in defense contracting.
avionics	Airborne electronics
AVGAS	Aviation gasoline
BOMARC	Boeing Michigan Aeronautical Research Center
bowser	Tank trailer
cantonment	Built-up area of a military (Army) installation
cation	Positively charged ion
$CaCO_3$	Calcium carbonate
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COMMSTA	Coast Guard Communication Station

decision tree	Logic diagram
DEQE	Department of Environmental Quality Engineering
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DOD	Department of Defense
Downgradient	In the direction of decreasing hydraulic static head; the direction in which groundwater flows
DPDO	Defense Property Disposal Office
DRMO	Defense Reutilization and Marketing Office
effluent	Discharge of liquid waste
EOD	Explosive Ordnance Demolition
EM	Enlisted man
EPA	U.S. Environmental Protection Agency
Epilimnion	Upper, wind-mixed waters of a lake
Evapotranspiration	Referring to the portion of precipitation returning to the atmosphere by direct evaporation or transpiration by vegetation
°F	degrees Fahrenheit
FIW	Fighter-Interceptor Wing
Fluvial	Sediments deposited through river floodplain deposition
ft	feet
gal/yr	gallons per year
Graded	Referring to the size range of grains or particles in a sediment
Granodiorite	An igneous magnesium-iron containing mineral consisting of quartz, oligoclase, and orthoclase
halogenated	Compounds containing halogen atoms (fluorine, chlorine, bromine, iodine)

HARM	Hazard Assessment Rating Methodology
infiltration	The flow of a liquid onto a substance through small pores
IRP	Installation Restoration Program
JP-4	Jet aircraft fuel
lenses	A body of a sediment type thick in the center and thinning toward the edges
MCL	Maximum contaminant level
mesotrophic	Referring to a lake with moderate nutrient levels and productivity
metalimnion	The region of a lake where water temperature changes rapidly as a function of depth
mg/L	milligram(s) per liter
MgN/L	milligram(s) of nitrogen per liter
MgP/L	milligram(s) of phosphorus per liter
MIBK	methyl isobutyl ketone
MMR	Massachusetts Military Reservation
MNHP	Massachusetts Natural Heritage Program
MOGAS	motor gasoline
MOU	memorandum of agreement
moraine	A mound or hill made up of glacial drift
mph	miles per hour
MSL	mean sea level
NCO	Noncommissioned Officer
NGB	National Guard Bureau
Ni-Cad	Nickel-cadmium
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Association

nonhalogenated	Molecules not containing halogen atoms
OEHL	Occupational and Environmental Health Laboratory
oligotrophic	A lake that contains low concentrations of nutrients, small standing crops of algae or vegetations, and has high water clarity
ORNL	Oak Ridge National Laboratory
PCB	Polychlorinated biphenyl - liquid used as a dielectric in electrical equipment; suspected human carcinogen; bioaccumulates in the food chain and causes toxicity to higher trophic levels
PCE	Tetrachloroethylene (perchloroethylene)
permeability	The capacity of a porous rock, soil, or sediment to transmit fluid without damage to the structure of the medium
pH	Negative logarithm of the hydrogen ion concentration; an expression of acidity or alkalinity
ppb	parts per billion
POL	petroleum, oils, and lubricants
RAP	Remedial Action Program
RCRA	Resource Conservation and Recovery Act
RMCL	Recommended Maximum Concentration Level
saturation	Referring to complete filling of the interstices of a rock or sediment
SPACECOM	Space Command
STP	Sewage Treatment Plant
TEAC	Technical Environmental Affairs Committee
TCA	1,1,1-Trichloroethane
TCE	trichloroethylene

μg/L	micrograms per liter
μmhos/cm	micromhos per centimeter
unconsolidated	Not cemented, referring to sediment overburden such as sand, silt, or clay rather than rock
USAF	U.S. Air Force
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
UTES	Unit Training Equipment Shop
VA	Veterans Administration
VOC	Volatile organic compounds

APPENDIX B
TEAM MEMBER BIOGRAPHICAL DATA

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0007.0.0

MICHAEL A. KEIRN, SENIOR SCIENTIST

Education

Purdue University - B.S. in Biological Sciences, 1965
University of Florida - M.S. in Environmental Engineering Sciences, 1968
University of Florida - Ph.D. in Environmental Engineering Sciences, 1977

Professional Experience

Dr. Keirn's areas of expertise include environmental chemistry, aquatic microbiology, bioassay/aquatic toxicology, and microbial ecology. He brings more than ten years of experience in environmental risk and impact analysis and the management of hazardous waste investigations to the Jordan Company. His project management activities have focused on multidisciplinary environmental surveys of uncontrolled hazardous waste sites, assessment of public health risk and environmental impacts, and development of remedial alternatives.

Dr. Keirn has managed four remedial investigation/feasibility study projects and has conducted assessments at numerous suspected hazardous waste sites. He is experienced in the management of all three field investigative phases of the Department of Defense Installation Restoration Program (IRP) for hazardous waste disposal sites including: Initial Assessments (Records Searches); Environmental Contamination Surveys; and Development of Alternatives (Contaminant Control Measures). For four years, he served in a technical review capacity as Project Quality Assurance Supervisor for the Phase I assessments of 104 installations for USATHAMA. He has also served as Assessment Team Leader and as Chemist and Ecologist for Phase I assessments for all three military branches, including the IAS of Allegeny Ballistics Laboratory, West Virginia for the U.S. Navy.

Dr. Keirn has managed Phase II contamination surveys of four installations for USATHAMA: Alabama Army Ammunition Plant; West Virginia Ordnance Works; Vint Hill Farms Station, Virginia; and Gateway Army Ammunition Plant, Missouri. These surveys have included the installation of more than 100 monitoring wells; groundwater, surface water, sewer, soil, sediment, air, building, and tissue sampling and analysis; and geohydrological assessments of contaminant migration. Dr. Keirn also directed overall Technical Support Services involving contamination surveys at ten U.S. Army installations. He has also managed or directed IRP Phase IV evaluations at several DOD installations to identify and rank candidate remedial measures to control hazardous contaminant migration, and develop concept designs and cost estimates for the recommended alternative.

In addition to CERCLA-related aspects, Dr. Keirn has also managed and directed environmental impact and public health assessments of toxic materials releases. These include solvents, explosives and propellants, white phosphorous, mercury, PCBs, dredge spoil, and paper mill effluents. He directed the assessment of the level, concentration and migration of PCBs present in the soil, groundwater and sediments after a spill at an active transformer storage yard in Arkansas.

Dr. Keirn was responsible for assessing the water quality impact due to maintenance dredging at sites in Florida and Mississippi. The project included a study of chemical water quality impact and biological impact assessment. For the U.S. Navy, he developed water quality impact assessment studies, including the impact of dredging and spoiling, for the siting of a naval base installation in Georgia. The environmental impact assessment of the proposed site was especially critical due to its location adjacent to a barrier island system and protected seashore.

Dr. Keirn developed an environmental assessment of mercury discharges from a peat harvesting operation in an environmentally critical area in North Carolina. Due to the potential for runoff of mercury from the dredging of peat, Dr. Keirn developed and implemented an in situ mercury bioaccumulation study of shellfish and fish in the river. He conducted bioassays on fish and monitored rate of uptake in clams and bluegill to determine the potential risks to the environment and public health. Dr. Keirn has performed assessments of the bacterial pathogens developing in paper mill wastes and was Technical Director of a comprehensive assessment of acute and chronic toxicity of paper mill effluent to aquatic species. This program evaluated the biological response of four freshwater fish species, three aquatic invertebrates, and an algal species to paper mill effluent.

Dr. Keirn has managed or performed numerous public health evaluations involving environmental exposure to industrial solvents, military explosives, and their transformation products. In addition, he has been involved in water quality criteria setting for nitrocellulose, nitroglycerin, RDX, HMX, and white phosphorus.

Dr. Keirn has provided expert witness testimony in sanitary microbiology and public health and serves as a member of the Standard Methods Committee on Periphyton. In addition, he has authored more than fifteen publications in the areas of public health microbiology, aquatic toxicology, aquatic ecology and environmental impact of hazardous wastes, and is co-author of a U.S. Fish and Wildlife Service manual on the impact of channelization on streams.

PETER S. BAKER, GEOLOGIST

Education

University of Maine - B.S. in Geology, 1982

Professional Experience

Mr. Baker's experience in the consulting field includes three years as a geologist in the field of exploration geology in support of the mining industry. During that time he assisted in the planning and implementation of various geochemical and geophysical surveys used in explorations for base metals, gold, silver, and peat. He participated in the field work for the Mount Chase (Getty Mining Co.) massive sulfide deposit in northern Maine. On that project, he assisted with the use of several geophysical instruments to target drill holes and delineate the ore body. Also, he logged drill core and was involved in the planning and implementation of various soil and stream sediment surveys. On another project, he assisted with researching and compiling data used in determining potential peat resources in Maine. During that project he was involved in aerial surveys, peat bog sampling, and the determination of acreage and tonnage of various peat deposits.

Mr. Baker's experience in the field of economic geology includes the training of others in geochemical sampling techniques and in the operation of various geophysical instruments. He assisted in analysis of data in determining subsurface geology. Further he assisted in implementing a geochemical survey for gold in northeastern Georgia as well as a gold targeted biogeochemical survey in eastern Maine for Amselco.

In addition to the geophysical survey techniques mentioned above, his technical experience also includes geologic mapping, soil and water testing, surveying, and drafting.

At Jordan, Mr. Baker has been involved in a project for the Office of Crystalline Repository Development to conduct a preliminary assessment and screening of crystalline rock bodies in the northeastern U.S. for use as a high-level nuclear waste repository.

Mr. Baker participated in the planning and implementation of site evaluations for Florida Department of Transportation I-595 Project. He was responsible for writing the exploration program for these sites. Mr. Baker was also field geologist in charge of supervising sampling and installation of monitoring wells at a number of PCB spill sites. He was involved in the installation of monitoring wells and soil and water sampling for the Long Term Monitoring Program at Love Canal for NYSDEC.

JOSEPH A. FARRY, CHEMICAL ENGINEER

Education

University of South Alabama - B.S. in Chemical Engineering, 1984.
Graduate Work - 12 hours of Graduate work in Computer Science.
Special Courses - "The Transport and Fate of Chemicals in the Environment", AICHE Continuing Education Course, April 1986, 16 hours, 4.0 CEU.

Professional Affiliations

Member of the American Institute of Chemical Engineers.
Passed the Engineer-In-Training Examination (EIT), September 1983.

Professional Experience

Mr. Farry is currently working on the design and evaluation of engineering systems to remediate gasoline contaminated groundwater and soils at service stations throughout Florida for three major oil companies. Project work includes the use of groundwater solute transport models for quantification and definition of the contamination, design and computer modeling and simulation (using Pascal) of remediation systems, design and manipulation of a database (using Lotus) for the evaluation of similar cleanup systems currently in use throughout Florida.

Mr. Farry was involved in the records search phase of the Air Force's Restoration Program to identify areas of possible contamination at a large military installation in the northeast. Duties included a three week tour of the installation for collection of records of past practices, observation of current operations, interviewing personnel at the installation, evaluation of the information collected, preparation of the report identifying potentially contaminated areas and the nature and scope of investigational work necessary to confirm and define contamination.

Mr. Farry's experience in soil chemistry includes the development of techniques for field analysis of volatile organic compounds for soil/sediment and water samples. He conducted a three week laboratory study to determine the response characteristics for the Photovac 10S50 portable gas chromatograph to certain hazardous organic compounds. He contributed to the structuring of a standard protocol to be followed in the field to ensure quality control criteria were met and wrote a detailed instruction manual for operation for the 10S50 with respect to this protocol. He field tested this protocol and directed the training of subsequent operators.

Mr. Farry was a member of the project team that conducted preliminary assessments and site inspections for the Florida Department of Environmental Regulation's CERCLA program. This program includes determining the relative hazard associated with uncontrolled hazardous waste sites and performing site reconnaissance and site inspections to determine the need for additional follow-up work at these sites.

He is experienced with modeling and computer simulation of chemical processes to formulate alternative processes to minimize waste produced. Mr. Farry has

worked as the plant superintendent for a plating facility with zinc, cadmium, nickel and chrome, hard chrome, brass and silver plating capabilities. Support processes included anodizing, etching, stripping, polishing and surface finishing. Mr. Farry was responsible for all plant operations, scheduling, maintenance, waste treatment and environmental compliance. Major project work included the design and implementation of a cost-effective wastewater treatment system.

LISA R. HOYT, ENGINEER

Education

University of Maine - B.S. in Mechanical Engineering, 1983

Affiliations

American Society of Mechanical Engineers

Professional Experience

Ms. Hoyt has been involved in Jordan's preliminary assessments in accordance with CERCLA requirements at 150 sites in the Fort Lauderdale area for the Florida Department of Environmental Regulation (FDER). Responsibilities included conducting file searches and organizing and indexing data available for each site. Other responsibilities included performing windshield surveys to collect supplemental data and maintaining contact with FDER officials and local environmental control boards. Upon completion of file-search activities, Ms. Hoyt was involved in data review and evaluation and drafting of preliminary assessment reports concerning Jordan's findings relative to each site.

She is currently involved in review and evaluation of groundwater samples; surface water samples; soil samples; and sample analyses from 15 of the 150 Fort Lauderdale sites and drafting site inspection reports for FDER.

APPENDIX C
LIST OF INTERVIEWEES

APPENDIX C
LIST OF INTERVIEWEES

	Interviewees	Years of Service at MMR
1.	Base Civil Engineer/ANG, Army (Retired)	43
2.	Base Environmental Engineer/ANG	35
3.	Chief Flight line Operations/USAF (Retired)	35
4.	Chief Facility Engineer/USCG	5
5.	General Foreman Roads and Grounds/USCG	13
6.	Supervisor Roads and Grounds/USCG	26
7.	Manager Base Service Station/USCG	7
8.	Utility Shop Foreman/USCG	27
9.	Supervisor Ground Support Maintenance/USCG	1½
10.	Medical Technician/USCG	3
11.	Lab Technician/USCG	2
12.	Shop Supervisor/USCG	13
13.	Shop Supervisor/USCG	12
14.	Maintenance Supervisor/USCG	16
15.	Hazardous Waste Coordinator/USCG	4
16.	Chief, Transmitter Station/USCG	3
17.	Technician, Transmitter Station/USCG	6
18.	Former Chief, Transmitter Station/USCG	3
19.	Maintenance Officer/USCG	16
20.	Aircraft Maintenance Officer/USCG	15

LIST OF OUTSIDE CONTACTS

The overall MMR IRP is coordinated with federal, state and local regulatory agencies, as well as the IRP management team and all MMR major command units through the Technical Environmental Affairs Committee (TEAC). Concerns and information related to the USCG facilities at MMR have been coordinated through this committee. Members of the TEAC not part of the MMR Command Structure are lised below. In addition to the listed TEAC personnel, on-site contacts for USCG facilities are:

Dr. William Kerfoot
K-V Associates
281 Main Street
Falmouth, MA 02540

Mr. Dennis LeBlanc
U.S. Geological Survey
150 Causway Street
Suite 1309
Boston, MA 02114-1384

LIST OF MEMBERS
MMR TEAC

Brigadier General Louis J. Ferrari
Deputy Adjutant General
MA National Guard
905 Commonwealth Avenue
Boston, MA 02215-1399

Mr. Joseph DeCola
Environmental Protection Agency
Region 1
J.F. Kennedy Building
Boston, MA 02203

Ms. Jane Alford
Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Room 2000
100 Cambridge Street
Boston, MA 02202

Mr. Paul Anderson
Regi al Environmental Engineer
MA Dept. of Environmental Quality Engineering
Southeast Region
Lakeville Hospital
Main Street
Lakeville, MA 02346

Ms. Virginia Valiela
Board of Selectmen
Town of Falmouth
59 Town Hall Square
Falmouth, MA 02540

Mr. John Gumbleton
Board of Selectmen
Town of Falmouth
59 Town Hall Square
Falmouth, MA 02540

Ms. V. Louise Behrman
Board of Selectmen
Town of Mashpee
Town Office Building
P.O. Box 1108
Mashpee, MA 02649

Mr. Thomas E. Fantozzi
Health Agent
Town of Bourne
24 Perry Avenue
Buzzards Bay, MA 02532

LIST OF MEMBERS
TEAC
(continued)

Mr. Edward Kelly
Town Engineer
Town of Sandwich
P.O. Box 660
130 Main Street
Sandwich, MA 02562

Mr. Stetson Hall
Barnstable County Health Department
Superior Court House
Route 6A
Barnstable, MA 02630

Mr. Ronald Watson, Chairman
Deputy Chief, Engineering Services Division
National Guard Bureau
The Pentagon
Washington, DC 20310

Mr. Walter Eno
Otis Task Force Representative
4 Crow's Nest Drive
Buzzards Bay, MA 02532

Mr. James Hensley
Environmental Resources Branch
ARNG Operating Activity Center
Bldg. 6810, Edgewood Area
Aberdeen Proving Grounds, MD
21010-5420

APPENDIX D
MASTER LIST OF SHOPS, USCG

MASTER LIST OF SHOPS, USCG

Shop Name	Current Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Typical Treatment
Special Services				
Auto Hobby Shop	3160	Yes	Yes	Contract Disposal
Golf Course	3349	Yes	Yes	Contract Disposal
Dry Cleaning Facility	1146	Yes	Yes	Contract Disposal
Supply Department				
Helo Hangar Supply	3170	No	No	
Fixed Wing Hangar Supply	128	No	No	
Rotary Wing Maintenance Div.				
Line Maintenance	3170	Yes	Yes	Contract Disposal
Avionics Electric Shop	3170	Yes	Yes	Contract Disposal
Avionics Work Shop	3170	Yes	Yes	Contract Disposal
H-3, H-52 Shops	3170	Yes	Yes	Contract Disposal
Metal Shop	3170	Yes	Yes	Contract Disposal
T-58 Engine Shop	3170	Yes	Yes	Contract Disposal
Fixed Wing Maintenance Div.				
Maintenance Control & Line	128	Yes	Yes	Contract Disposal
AD Shop & Rt F-3 Shop	128	Yes	Yes	Contract Disposal
AE Shop	128	Yes	Yes	Contract Disposal
AM Shop	128	Yes	Yes	Contract Disposal
ASM Shop	128	Yes	Yes	Contract Disposal
AT Shop	128	Yes	Yes	Contract Disposal
Medical Department				
Dental Clinic	5200	No	No	
Medical Supply & Preventive Medicine	5200	Yes	Yes	To Waste Treatment Plant
Facilities Engineering Dept.				
Roads & Grounds	5215	Yes	Yes	Contract Disposal
Utilities Shop	5215	No	No	
Carpenter & Maintenance Shop	3456	Yes	Yes	Contract Disposal
Electric Shop	5215	Yes	Yes	Contract Disposal
Air Station Grounds Maintenance	3161	Yes	Yes	Contract Disposal
Miscellaneous				
COMMSTA Boston Transmitter Site	4700	Yes	Yes	Contract Disposal
Service Station	5202	Yes	Yes	Contract Disposal

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0024.0.0

APPENDIX E
WATER QUALITY CRITERIA

MASSACHUSETTS SURFACE WATER
QUALITY STANDARDS
CLASS B

Source:	<u>Code of Massachusetts Regulations</u> 314 CMR 400
314 CMR 4.03:	Minimum Water Quality Criteria and Associated Uses.
<u>Class B</u> -	Waters assigned to the class are designated for the uses of protection and propagation of fish, other aquatic life, and wildlife and for primary and secondary contact recreation.

<u>Minimum Criteria Applicable To All Waters</u>:

A. These minimum criteria are applicable to all surface waters, unless criteria specified for individual classes are more stringent.

	PARAMETER	CRITERIA
1.	Aesthetics	All waters shall be free from pollutants in concentrations or combinations that: (a) Settle to form objectionable deposits; (b) Float as debris, scum, or other matter to form nuisances; (c) Produce objectionable odor, color, taste, or turbidity; or (d) Result in the dominance of nuisance species.
2.	Radioactive Substances	Shall not exceed the recommended limits of the United States Environmental Protection Agency's National Drinking Water Regulations.
3.	Tainting Substances	Shall not be in concentrations or combinations that produce undesirable flavors in the edible portions of aquatic organisms.
4.	Color, Turbidity, Total Suspended Solids	Shall not be in concentrations or combinations that would exceed the recommended limits on the most sensitive receiving water use.
5.	Oil and Grease	The water surface shall be free from floating oils, grease, and petrochemicals, and any concentrations or combinations in the water column or sediments that are aesthetically objectionable or deleterious to the biota are prohibited. For oil and grease of petroleum origin the maximum allowable discharge concentration is 15 mg/L.

6.	Nutrients	Shall not exceed the site-specific limits necessary to control accelerated or cultural eutrophication.
7.	Other Constituents	Waters shall be free from pollutants in concentrations or combinations that: (a) Exceed the recommended limits on the most sensitive receiving water use; (b) Injure, are toxic to, or produce adverse physiological or behavioral responses in humans or aquatic life; or (c) Exceed site-specific safe exposure levels determined by bioassay using sensitive species.

Specific Criteria For Class B Waters:

	PARAMETER	CRITERIA
1.	Dissolved Oxygen	Shall be a minimum of 5.0 mg/L in warm water fisheries and a minimum of 6.0 mg/L in cold water fisheries.
2.	Temperature	Shall not exceed 83°F (28.3°C) in warm water fisheries or 68°F (20°c) in cold water fisheries, nor shall the rise resulting from artificial origin exceed 4.0°F (2.2°C).
3.	pH	Shall be in the range of 6.5 - 8.0 standard units and not more than 0.2 units outside of the naturally occurring range.
4.	Fecal Coliform Bacteria	Shall not exceed a log mean for a set of samples of 200 per 100 mL, nor shall more than 10% of the total samples exceed 400 per 100 mL during any monthly sampling period.

Provisions For Control of Eutrophication

The discharge of nutrients, primarily phosphorus or nitrogen, to surface waters will be limited or prohibited by the Division as necessary to prevent excessive eutrophication of such waters. There shall be no new or increased discharges of nutrients into lakes and ponds or tributaries thereto. Existing discharges containing nutrients that encourage eutrophication or growth of weeds or algae shall be treated. Activities that may result in nonpoint discharges of nutrients shall be conducted in accordance with the best management practices reasonably determined by the Division to be necessary to preclude or minimize such discharges of nutrients.

FEDERAL GROUNDWATER QUALITY CRITERIA

PRIMARY DRINKING WATER STANDARDS:
40 Code of Federal Regulations 141.11

INORGANIC CHEMICALS:

	(mg/L)
Arsenic	0.05
Barium	1
Cadmium	0.010
Chromium	0.05
Lead	0.05
Mercury	0.002
Nitrate (as N)	10
Selenium	0.01
Silver	0.05

ORGANIC CHEMICALS:

	(mg/L)
Chlorinated Hydrocarbon Pesticides	
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
Total Trihalomethanes	0.1
Chlorophenoxy Herbicides	
2,4-D	0.1
2,4,5-TP (Silvex)	0.01

SECONDARY DRINKING WATER REGULATIONS
40 Code of Federal Regulations 143.3

Contaminant	Level
Chloride	250 mg/L
Color	15 color units
Copper	1 mg/L
Corrosivity	Noncorrosive
Foaming agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5-8.5
Sulfate	250 mg/L
Total dissolved solids (TDS)	500 mg/L
Zinc	5 mg/L

FEDERAL PROPOSED RECOMMENDED MAXIMUM
CONTAMINANT LEVELS (RMCL) AND MAXIMUM
CONTAMINANT LEVELS

EPA FINAL RMCLs & PROPOSED MCLs
[for Volatile Chemicals, VOCs]

CHEMICAL	RMCL (ug/L)	PROPOSED MCL (ug/L)
Benzene	0	5
Vinyl Chloride	0	1
Carbon Tetrachloride	0	5
1,2-Dichloroethane	0	5
Trichloroethylene	0	5
1,1-Dichloroethylene	7	7
1,1,1-Trichloroethane	200	200
p-Dichloroebenzene	750	750

PROPOSED RMCLs
for SYNTHETIC ORGANIC CHEMICALS (SOCs)

CHEMICAL	PROPOSED RMCL (ug/L)
Acrylamide	0
Alachlor	0
Chlordane	0
Dibromochloropropane (DBCP)	0
Ethylene dibromide (EDB)	0
Epichlorohydrin	0
Heptachlor	0
Heptachlor epoxide	0
Polychlorinated biphenyls (PCBs)	0
1,2-Dichloropropane	6
Lindane	0.2
Monochlorobenzene	60
Styrene	140
Aldicarb/aldicarb sulfoxide & sulfone	9
Carbofuran	36
cis-1,2-Dichloroethylene	70
o & m-Dichlorobenzene	620
2,4-D	70
Ethylbenzene	680
Methoxychlor	340
Pentachlorophenol	220
Toluene	2000
2,4,5-TP	52
trans-1,2-Dichloroethylene	70
Xylene, o, m, & p	440

Source:
USEPA Federal Register, Vol. 50, (219) 46880-47022, Nov. 13, 1985.

APPENDIX F
WATER QUALITY DATA

TABLE F-1
OSBORNE POND DATA

SOURCE: Otis ANGB/SGPM 1986

0.20

2. LABORATORY PERFORMING ANALYSIS	3. LAB SAMPLE NUMBER	4. REQUESTOR SAMPLE NO
OEHL	67382 00008	GN8400B 00020

SAMPLE COLLECTION INFORMATION

7. SITE DESCRIPTION		5. DATE RECEIVED BY LAB: 3 Dec 84	6. DATE ANALYSIS COMPLETED: 13 Dec 84

ON-SITE ANALYTICAL RESULTS

8. SITE LOCATION NO: OSBORNE POND	9. FLOWRATE AT SITE 00058 GAL/MIN	10. WEATHER 00041	16. WATER TEMP 00010 °C	17. PH 00400 UNITS	18. DISS O2 00300 MG/L
11. COLLECTION DATE/PERIOD		12. COLLECTORS NAME	19. RESULTS OF OTHER ON-SITE ANALYSES		
13. SAMPLING TECHNIQUE		14. PHONE NUMBER			
15. REASON FOR SAMPLE SUBMISSION: NPDES					

DEC 12 33 PM '84

ANALYSES REQUESTED AND RESULTS

PRESERVATION GROUP A		
PARAMETER	TOTAL	MG/L
Chemical Oxygen Demand	00340	
Total Organic CARBON as C	00680	

PRESERVATION GROUP B		
PARAMETER	TOTAL	MG/L
OIL & GREASE FREON-IR Method	00560	

PRESERVATION GROUP C		
PARAMETER	TOTAL	MG/L
AMMONIA as N	00610	
NITRATE as N Cd Reduct. Method	00620	
NITRITE as N	00615	
TOTAL KJELDAHL NITROGEN as N	00625	
PHOSPHORUS Ortho PO4 as P	70507	
PHOSPHORUS as P	00665	

PRESERVATION GROUP D		
PARAMETER	TOTAL	MG/L
CYANIDE	00720	
CYANIDE Free, Amenable to Cl_2	00722	

PRESERVATION GROUP E		
PARAMETER	TOTAL	µG/L
PHENOLS	32730	

PRESERVATION GROUP F 352			
PARAMETER	DISS	TOTAL	µG/L
Primary ARSENIC	01000	01002	<10
BARIUM	01005	01007	268
CADMIUM	01025	01027	<10
CHROMIUM	01030	01034	<50
CHROMIUM Hexavalent		01032	
COPPER Secondary	01040	01042	24
IRON	01046	01045	154
LEAD	01049	01051	<20
MANGANESE	01056	01055	<50
MERCURY	71890	71900	<1
NICKEL	01065	01067	
SELENIUM	01145	01147	
SILVER	01075	01077	<10
ZINC	01090	01092	<50
CALCIUM as Ca	00915	00916	mg/l
MAGNESIUM as Mg	00925	00927	mg/l
POTASSIUM	00935	00937	mg/l
SODIUM	00930	00929	mg/l

PRESERVATION GROUP G		
PARAMETER	TOTAL	MG/L
BORON	01022	µg/l
BORON, Dissolved	01020	µg/l
CHLORIDE	00940	
COLOR	00080	Units
FLUORIDE	00951	
Residue Filterable (TDS)	00515	
Residue Non Filt (SS)	00530	
Residue	00500	
Residue Volatile	00505	
Specific Conductance	00095	µmhos
SULFATE as SO_4	00945	
SURFACTANTS MBAS as LAS	38260	
TURBIDITY	00076	Units

PRESERVATION GROUP J		
PARAMETER		

1. ORGANIZATION REQUESTING ANALYSIS	CHEMIST
Otis ANGB, Ma.	EH WH
	REVIEWED BY
	APPROVED BY [signature]

8.28

2. LABORATORY PERFORMING ANALYSIS	3. LAB SAMPLE NUMBER	4. REQUESTOR SAMPLE NO
OEHL	67384 00008	GN84CC28 00028

SAMPLE COLLECTION INFORMATION		5. DATE RECEIVED BY LAB	6. DATE ANALYSIS COMPLETED
7. SITE DESCRIPTION		30 Dec 84	12 Dec 84

8. SITE LOCATION NO	9. FLOWRATE AT SITE 00058 GAL/MIN	10. WEATHER 00041
OSBORNE POND		
11. COLLECTION DATE/PERIOD DEC 3 12 33 PM '84		12. COLLECTORS NAME
13. SAMPLING TECHNIQUE		14. PHONE NUMBER
15. REASON FOR SAMPLE SUBMISSION NPDES #		

ON-SITE ANALYTICAL RESULTS

16. WATER TEMP 00010 °C	17. PH 00400 UNITS	18. DISS O_2 00300 MG/L

19. RESULTS OF OTHER ON-SITE ANALYSES

ANALYSES REQUESTED AND RESULTS

PRESERVATION GROUP A		
PARAMETER	TOTAL	MG/L
Chemical Oxygen Demand	00340	
Total Organic CARBON as C	00680	
PRESERVATION GROUP B		
PARAMETER	TOTAL	MG/L
OIL & GREASE FREON-IR Method	00560	
PRESERVATION GROUP C 3--		
PARAMETER	TOTAL	MG/L
AMMONIA as N	00610	
NITRATE as N Cd Reduct. Method	00620	< .1
NITRITE as N	00615	
TOTAL KJELDAHL NITROGEN as N	00625	
PHOSPHORUS Ortho PO4 as P	70507	
PHOSPHORUS as P	00665	
PRESERVATION GROUP D		
PARAMETER	TOTAL	MG/L
CYANIDE	00720	
CYANIDE Free, Amenable to Cl_2	00722	
PRESERVATION GROUP E		
PARAMETER	TOTAL	µG/L
PHENOLS	32730	

PRESERVATION GROUP F			
PARAMETER	DISS	TOTAL	µG/L
ARSENIC	01000	01002	
BARIUM	01005	01007	
CADMIUM	01025	01027	
CHROMIUM	01030	01034	
CHROMIUM Hexavalent		01032	
COPPER	01040	01042	
IRON	01046	01045	
LEAD	01049	01051	
MANGANESE	01056	01055	
MERCURY	71890	71900	
NICKEL	01065	01067	
SELENIUM	01145	01147	
SILVER	01075	01077	
ZINC	01090	01092	
CALCIUM as Ca	00915	00916	mg/l
MAGNESIUM as Mg	00925	00927	mg/l
POTASSIUM	00935	00937	mg/l
SODIUM	00930	00929	mg/l

PRESERVATION GROUP G		
PARAMETER	TOTAL	MG/L
BORON	01022	µg/l
BORON, Dissolved	01020	µg/l
CHLORIDE	00940	
COLOR	00080	Units
FLUORIDE	00951	
Residue Filterable (TDS)	00515	
Residue Non Filt (SS)	00530	
Residue	00500	
Residue Volatile	00505	
Specific Conductance	00095	µmhos
SULFATE as SO_4	00945	
SURFACTANTS MBAS as LAS	38260	
TURBIDITY	00076	Units

PRESERVATION GROUP J		
PARAMETER		

1. ORGANIZATION REQUESTING ANALYSIS

Otis ANGB, Ma.

CHEMIST: KAL

REVIEWED BY

APPROVED BY

AMD FORM 2?1 — NON-POTABLE WATER ANALYSIS

28

WATER QUALITY CG.

2. LABORATORY PERFORMING ANALYSIS	3. LAB SAMPLE NUMBER	5. DATE REC LAB
OEHL	67385 00001	3 Dec

SAMPLE COLLECTION INFORMATION

7. SITE DESCRIPTION			
8. SITE LOCATION NO: DEEP KNEE POND	9. FLOWRATE AT SITE 00059	10. WEATHER 00041	16. WATER 000 °C
11. COLLECTION DATE/PERIOD	12. COLLECTORS NAME	19. RESULTS OF OTHER ON-SITE ANALYSES	
13. SAMPLING TECHNIQUE	14. PHONE NUMBER		
15. REASON FOR SAMPLE SUBMISSION NPDES #			

DEC 3 12 33 PM '84

ANALYSES REQUESTED AND RESULTS

PARAMETER	TOTAL	MG/L
PRESERVATION GROUP A		
Chemical Oxygen Demand	00340	
Total Organic CARBON as C	00680	
PRESERVATION GROUP B		
OIL & GREASE FREON-IR Method	00560	
PRESERVATION GROUP C		
AMMONIA as N	00610	
NITRATE as N Cd Reduct. Method	00620	
NITRITE as N	00615	
TOTAL KJELDAHL NITROGEN as N	00625	
PHOSPHORUS Ortho PO4 as P	70507	
PHOSPHORUS as P	00665	
PRESERVATION GROUP D		
CYANIDE	00720	
CYANIDE Free, Amenable to Cl_2	00722	
PRESERVATION GROUP E (µG/L)		
PHENOLS	32730	

PRESERVATION GROUP F

PARAMETER	DISS	TOTAL	µG/L
ARSENIC	01000	01002	
BARIUM	01005	01007	
CADMIUM	01025	01027	
CHROMIUM	01030	01034	
CHROMIUM Hexavalent		01032	
COPPER	01040	01042	
IRON	01046	01045	
LEAD	01049	01051	
MANGANESE	01056	01055	
MERCURY	71890	71900	
NICKEL	01065	01067	
SELENIUM	01145	01147	
SILVER	01075	01077	
ZINC	01090	01092	
CALCIUM as Ca	00915	00916	mg/l
MAGNESIUM as Mg	00925	00927	mg/l
POTASSIUM	00935	00937	mg/l
SODIUM	00930	00929	mg/l

PRESERVATION GROUP G 345

PARAMETER	TOTAL	MG/L
BORON	01022	µg/l
BORON, Dissolved	01020	µg/l
CHLORIDE	00940	16
COLOR	00080	35 Units
FLUORIDE	00951	< .12
Residue Filterable (TDS)	00515	69.0
Residue Non Filt (SS)	00530	
Residue	00500	
Residue Volatile	00505	
Specific Conductance	00095	µmhos
SULFATE as SO_4	00945	6
SURFACTANTS MBAS as LAS	38260	<.1
TURBIDITY	00076	2 Units

PRESERVATION GROUP J

PARAMETER		

1. ORGANIZATION REQUESTING ANALYSIS

USAF CLINIC /SGPM
OTIS ANGB, MA
02542-5001
Otis ANGB, Ma.

CHEMIST

REVIEWED BY

APPROVED BY

AMD FORM 201

NON-POTABLE WATER ANALYSIS

TABLE F-2
HISTORICAL ASHUMET POND AND JOHNS POND
WATER QUALITY DATA

SOURCE: Duerring and Rojko (1984)

ASHUMET POND

COMMUNITY: Mashpee/Falmouth

LOCATION: Ashumet Pond is located in the towns of Mashpee and Falmouth, with approximately 3/4 of the pond existing in Mashpee. The pond lies just east of Sandwich Road and 3/4 miles northeast of state Route 151 and less than 1/2 mile south of Otis Air Force Base.

WATERSHED: Cape Cod

DESCRIPTION: The development of the watershed along the perimeter of Ashumet Pond is moderate to heavy consisting of summer cottages and year-round dwellings along all except the northernmost shoreline. The outlying portions of the watershed are mostly forested and undeveloped.

INLETS: One inlet enters the pond from the northeast, originating in a cranberry bog approximately 1/4 mile to the north of the pond.

OUTLETS: None observed

DATE SAMPLED: 13 August 1980

THERMAL CHARACTERISTICS: Stratified

TROPHIC LEVEL: Mesotrophic

PHYTOPLANKTON: Low to moderate counts dominated by coccoid green algae.

AQUATIC MACROPHYTON: The major portions of this deep pond are weed free. Dense patches of macrophtyes were observed in the shallower portions of the northwest and western shore area and patches of moderate density were seen in the southern coves. The major species found include Eleocharis sp. (spike rush), Nitella sp. (muskgrass) and Najas sp. (bushy pondweed)

RECREATIONAL USES: Fishing, swimming and boating.

ACCESS: Public boat launching site accessible from Sandwich Road.

ASHUMET POND

KEY TO AQUATIC MACROPHYTES LISTED IN ORDER OF RELATIVE ABUNDANCE

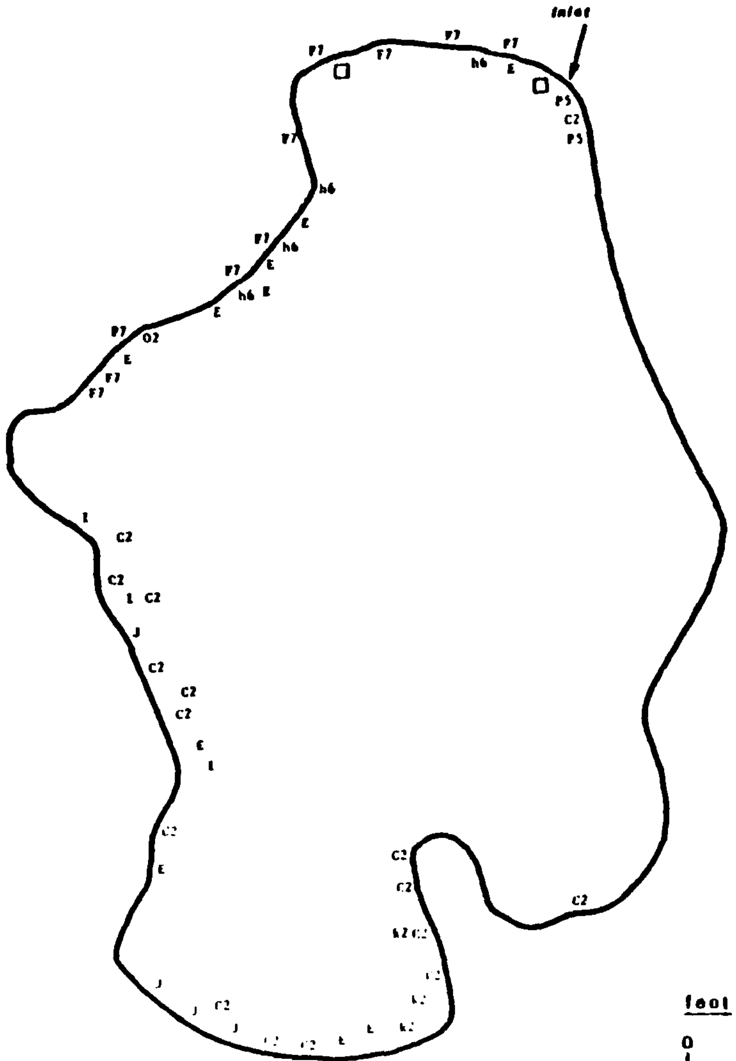
E - Eleocharis (Spike Rush)
F7 - Gratiola sp. (Hedge Hyssop)
h6 - Myriophyllum tenellum (Leafless Milfoil)
O2 - Lobelia Dortmanna (Water Lobelia)
C2 - Nitella (Stonewort)
k2 - Elatine sp. (Waterwort)
J - Najas sp. (Bushy Pondweed)
I - Isoetes sp. (Quillwort)
☐ - Moss
S - Sparganium sp. (Bur Reed)
P5 - Potamogeton epihydrus (Ribbonleaf Pondweed)

TABLE 1
ASHUMET POND
WATER QUALITY DATA (mg/l)
13 August 1980

STATION:	1 (Surface)	1 (26 ft)	1 (53 ft)	2 (Inlet)
PARAMETER				
pH (Standard Units)	7.2	7.2	6.7	7.3
Total Alkalinity	0.9	11	7	21
Total Hardness	17	16	19	26
Suspended Solids	0.0	0.5	0.5	13
Total Solids	50	56	74	84
Specific Conductance (µmhos/cm)	88	86	98	98
Chloride	12	11	11	9
Ammonia-Nitrogen	0.07	0.24	0.74	0.16
Nitrate-Nitrogen	0.1	0.1	0.0	0.1
Total Kjeldahl-Nitrogen	0.39	0.47	1.00	0.58
Total Phosphorus	0.01	0.01	0.18	0.01
Total Iron	0.02	0.01	1.20	2.00
Total Manganese	0.06	0.33	2.20	2.00

ASHUMET POND, Mashpee/Falmouth / Cape Cod Drainage Area

Figure 2
AQUATIC MACROPHYTE SURVEY



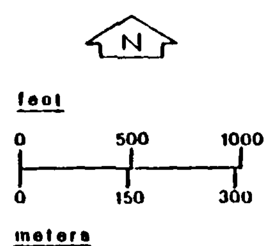
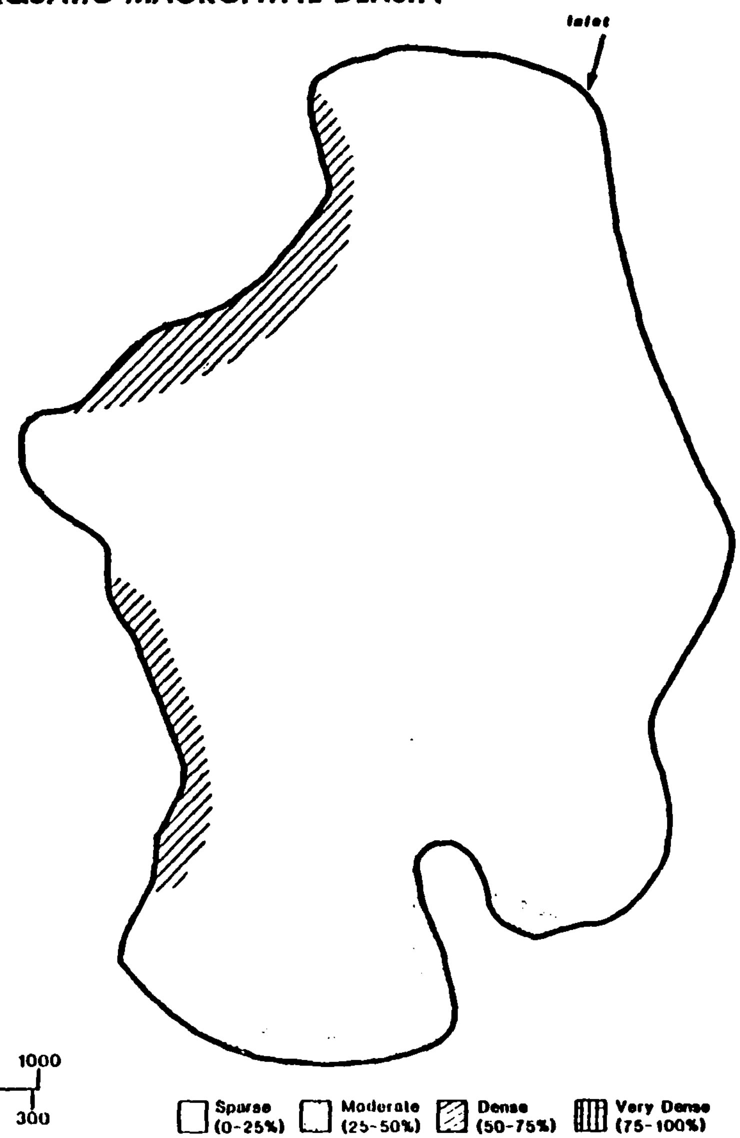


Figure 3
AQUATIC MACROPHYTE DENSITY



ASHUMET POND, Mashpee/Falmouth / Cape Cod Drainage Area

Figure 4
BATHYMETRY AND SAMPLE STATIONS

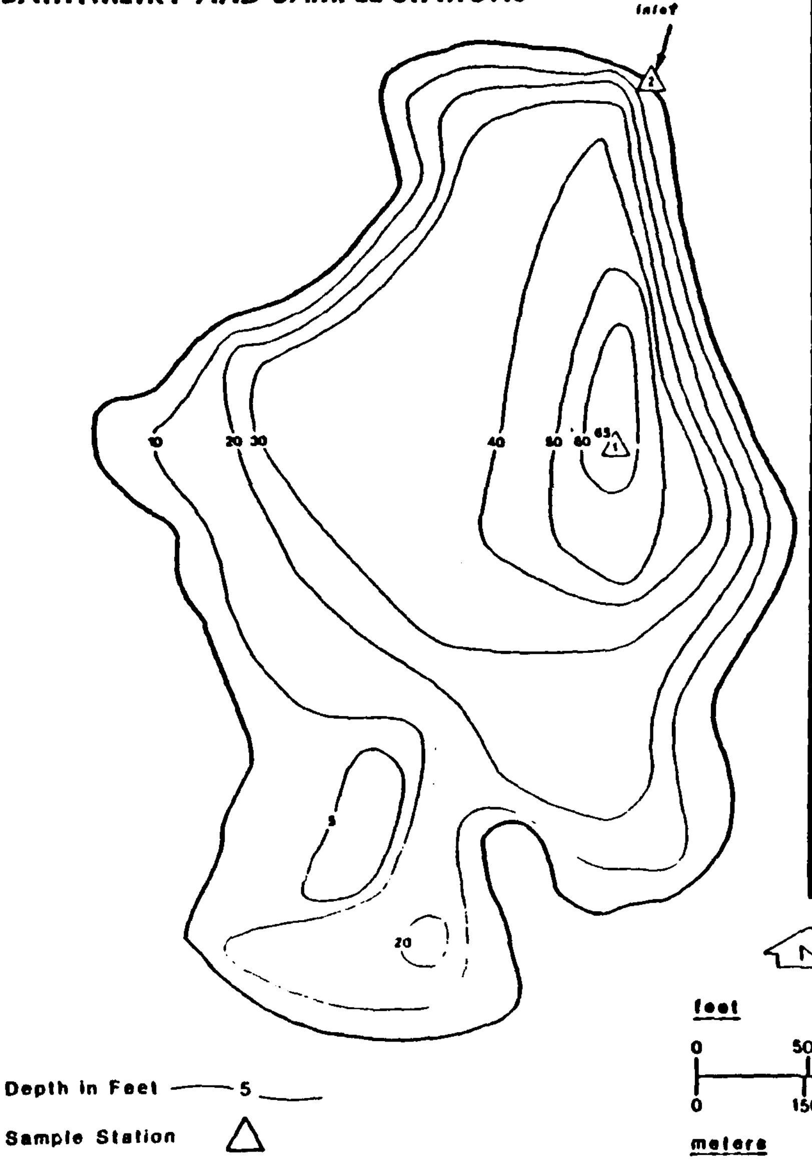
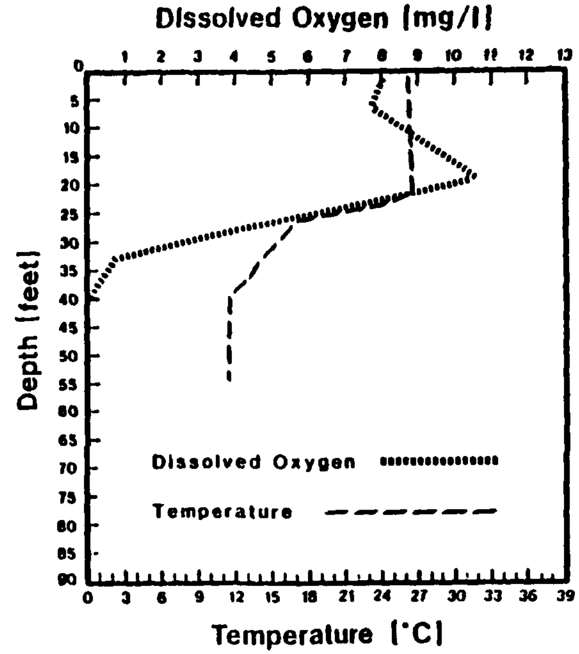


Figure 5
DISSOLVED OXYGEN & TEMPERATURE PROFILES
13 August 1980



STATION 1

DEPTH (ft.)	DEPTH (m)	D.O. (mg/l)	TEMP. (°C)	DEPTH (ft.)	DEPTH (m)	D.O. (mg/l)	TEMP. (°C)
1.6	0.5	8.0	26.0	29.5	9.0	--	15.0
3.3	1.0	--	26.0	32.8	10.0	0.7	13.5
6.6	2.0	7.8	26.0	36.1	11.0	--	13.0
9.8	3.0	--	26.0	39.4	12.0	0.0	11.5
13.1	4.0	--	26.0	42.6	13.0	--	11.5
16.4	5.0	--	26.0	45.9	14.0	--	11.5
19.7	6.0	10.6	26.0	49.2	15.0	--	11.5
23.0	7.0	--	24.0	52.5	16.0	0.0	11.5
26.2	8.0	5.4	17.0				

Secchi Disk Transparency 8 ft. (2.4 m)

TABLE 2

ASHUMET POND

MORPHOMETRIC DATA

Maximum Length	1,356 m	(4,450 ft)
Maximum Effective Length	1,356 m	(4,450 ft)
Maximum Width	991 m	(3,250 ft)
Maximum Effective Width	991 m	(3,250 ft)
Maximum Depth	20 m	(65 ft)
Mean Depth	7 m	(23 ft)
Mean Width	605 m	(1,987 ft)
Area	82 ha	(203 acres)
Volume	5,915,866 m^3	(4,796 acre-ft)
Shoreline	3,901 m	(12,800 ft)
Development of Shoreline	1.2	
Development of Volume	1.0	
Mean to Maximum Depth Ratio	0.35	

TABLE 3

ASHUMET POND

STATION 1 (composite)

PHYTOPLANKTON ENUMERATION

13 August 1980

ORGANISM		Cells/ml
Bacillariophyceae (Diatoms)		
Synedra sp.	112	
Subtotal		112
Chlorophyceae (Greens)		
Coelastrum sp.	28	
Sphaerocystis sp.	364	
Staurastrum sp.	28	
Subtotal		420
Cryptophyceae (Cryptomonads)		
Cryptomonas sp.	56	
Subtotal		56
Cyanophyceae (Blue-Greens)		
Anacystis sp.	224	
Subtotal		224
Total		812

JOHNS POND

COMMUNITY: Mashpee

LOCATION: Located approximately 1000 feet east of Ashumet Pond and 1/2 mile south of Otis Air Force Base in the western section of Mashpee.

WATERSHED: Cape Cod

DESCRIPTION: Residential development is found predominantly along the southern and eastern shore of the pond and in the northern section of the watershed associated with Otis Air Force Base. Almost half of the entire watershed is forested.

INLETS: One inlet originating from Moody Pond flows into the northern end of the pond.

OUTLETS: Two outlets exist: one flows out of the southern tip of the pond as the Childs River and the other exits from the north-eastern tip as the Quashnet River.

DATE SAMPLED: 17 August 1978 and 13 August 1980. These surveys occurred during a Diagnostic//Feasibility study of Johns Pond from 1978-1980. Complete report of this study is contained under a separate cover.

THERMAL CHARACTERISTICS: Stratified

TROPHIC LEVEL: Mesotrophic

PHYTOPLANKTON: Very low total counts observed on both 1978 and 1980 survey dates with no particular species dominating.

AQUATIC MACROPHYTON: Macrophyte density and diversity increased over the two year span from sparse to moderate with Eriocaulon sp. (Pipewort) the dominant species in 1980.

RECREATION USES: Swimming, boating and fishing.

ACCESS: Two public access points for boating and fishing exist. One on the eastern shore and the other on the northwest shore reached via Hoophole Road.

JOHNS POND

KEY TO AQUATIC MACROPHYTES LISTED IN ORDER OF RELATIVE ABUNDANCE

13 August 1980

- e1 - *Eriocaulon* sp. (Pipewort)
- F7 - *Gratiola* sp. (Hedge Hyssop)
- O2 - *Lobelia Dortmanna* (Water Lobelia)
- △ - Macroscopic Algae
- C1 - *Chara* sp. (Muskgrass)
- j1 - *Iris* sp. (Iris)
- P - *Potamogeton* sp. (Pondweed)
- E - *Eleocharis* sp. (Spike Rush)
- k2 - *Elatine* sp. (Waterwort)
- j2 - *Juncus* sp. (Rush)
- U - *Utricularia* sp. (Bladderwort)
- h6 - *Myriophyllum tenellum* (Leafless Milfoil)
- J - *Najas* sp. (Bush Pondweed)
- K1 - *Callitriche* sp. (Water Starwort)
- H1 - *Vallisneria americana* (Wild Celery)
- Q2 - *Polygonum* sp. (Smartweed)
- W2 - *Pontederia cordata* (Pickerelweed)
- A3 - *Sagittaria* sp. (Arrowhead)
- V1 - *Decodon verticillatus* (Swamp Loosestrife)
- q - *Phragmites maximus* (Reed Grass)
- h5 - *Myriophyllum humile* (Water Milfoil)
- Z2 - *Eupatorium* sp. (Joe-pye Weed)
- Z5 - *Solidago* sp. (Goldenrod)
- B - *Scirpus* sp. (Bulrush)
- H2 - *Elodea* sp. (Waterweed)
- n1 - *Brasenia Schreberi* (Water Shield)
- V3 - *Ludwigia* sp. (False Loosestrife)
- E2 - *Eleocharis Smallii* (Spike Rush)

JOHNS POND, Mashpee / Cape Cod Drainage Area

Figure 79

AQUATIC MACROPHYTE SURVEY

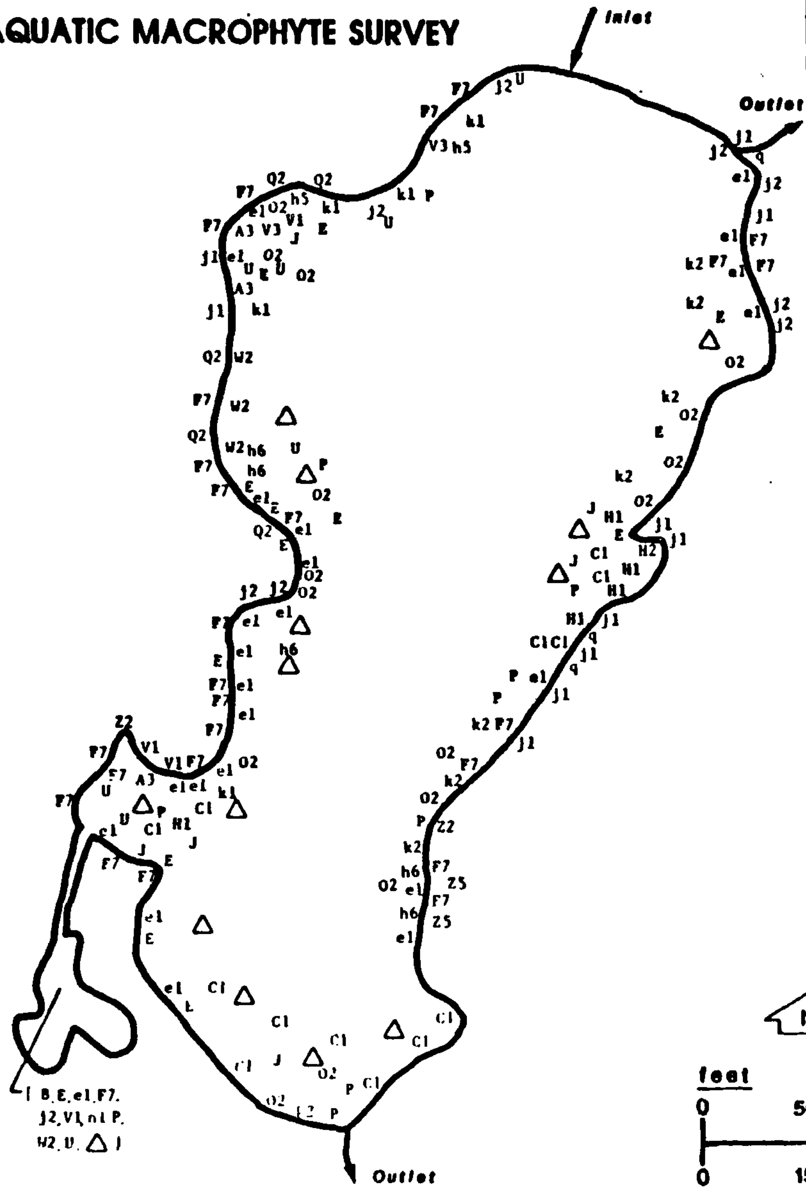


Figure 80

AQUATIC MACROPHYTE DENSITY

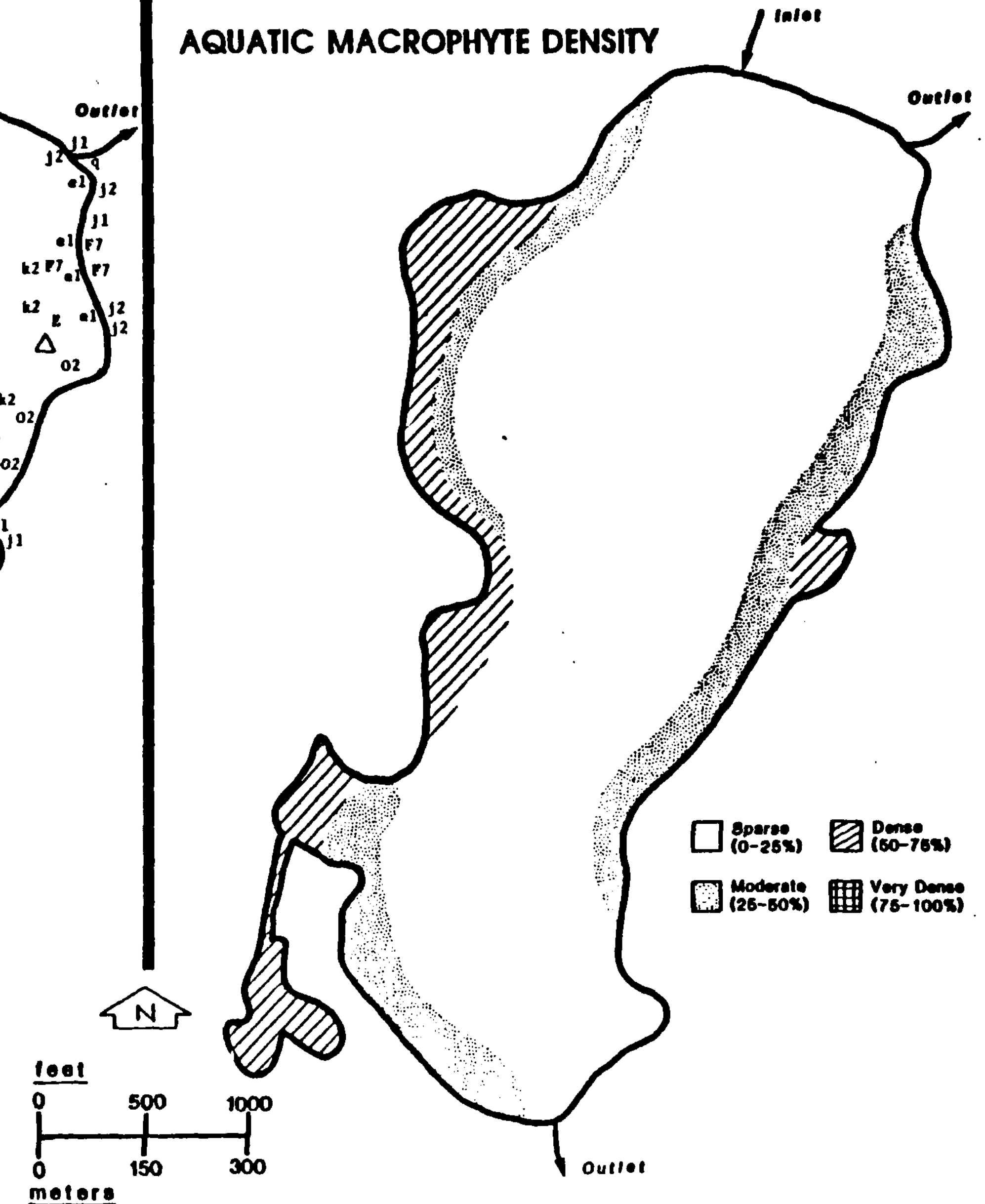


TABLE 57a

JOHNS POND

WATER QUALITY DATA (mg/l)

17 August 1978

STATION: PARAMETER	1 (Surface)	1 (35 ft)	1 (57 ft)	2 (Surface)	3 (Canal)	4 (Inlet)	5 (Outlet)
pH (Standard Units)	6.8	6.4	6.5	6.8	6.5	5.8	6.4
Total Alkalinity	7	9	19	8	8	6	8
Total Hardness	15	14	16	16	14	20	14
Specific Conductance (μmhos/cm)	75	76	86	76	78	87	75
Silica	0.4	0.0	2.4	0.0	0.2	7.6	0.6
Chloride	10	11	11	10	11	10	10
Color (Standard Platinum Units)	5	5	5	5	10	20	5
Ammonia-Nitrogen	0.00	0.01	0.47	0.01	0.01	0.01	0.01
Nitrate-Nitrogen	0.0	0.0	0.0	0.0	0.0	0.9	0.0
Total Phosphorus	0.04	0.03	0.05	0.03	0.03	0.03	0.04
Total Iron	0.10	0.05	1.20	0.05	0.10	0.40	0.03
Total Manganese	0.05	0.03	1.00	0.02	0.01	0.10	0.01
Total Coliform Bacteria per 100 ml	10	-	-	5	160	520	160
Fecal Coliform Bacteria per 100 ml	5	-	-	5	5	20	10

TABLE 57b

JOHNS POND

WATER QUALITY DATA (mg/l)

13 August 1980

STATION: PARAMETER	1 (Surface)	1 (35 ft)	1 (57 ft)	2 (Surface)	2 (16 ft)	2 (30 ft)	5* (Outlet)
pH (Standard Units)	6.5	6.6	7.3	6.9	7.3	6.8	7.2
Total Alkalinity	6	10	15	6	10	23	8
Total Hardness	15	16	16	15	15	16	15
Specific Conductance (μmhos/cm)	82	80	86	80	80	80	80
Chloride	11	11	11	10	10	10	11
Ammonia-Nitrogen	0.05	0.05	0.45	0.05	0.03	0.09	0.09
Nitrate-Nitrogen	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Total Kjeldahl-Nitrogen	0.38	0.50	0.23	0.28	0.37	0.39	0.42
Total Phosphorus	0.07	0.03	0.04	0.01	0.01	-	0.06
Total Iron	0.00	0.03	0.45	0.00	0.00	0.00	0.03
Total Manganese	0.02	0.07	1.00	0.00	0.00	0.00	0.03

* no flow

Figure 81

BATHYMETRY AND SAMPLE STATIONS

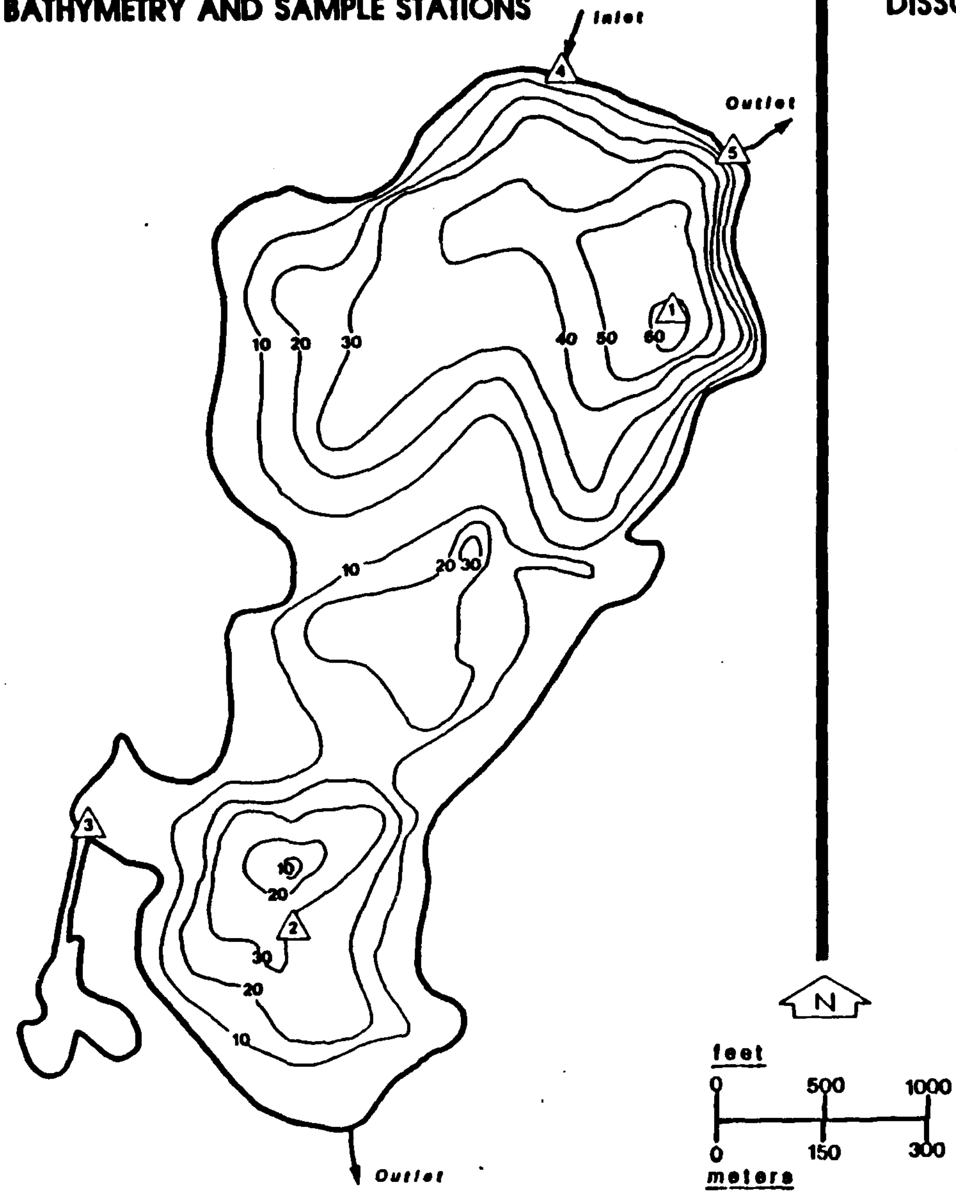
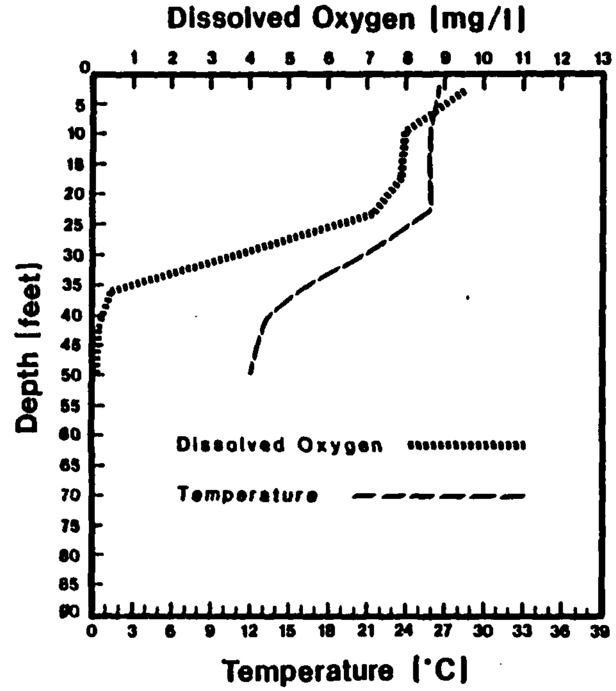


Figure 82A

DISSOLVED OXYGEN & TEMPERATURE PROFILES
13 August 1980



STATION 1

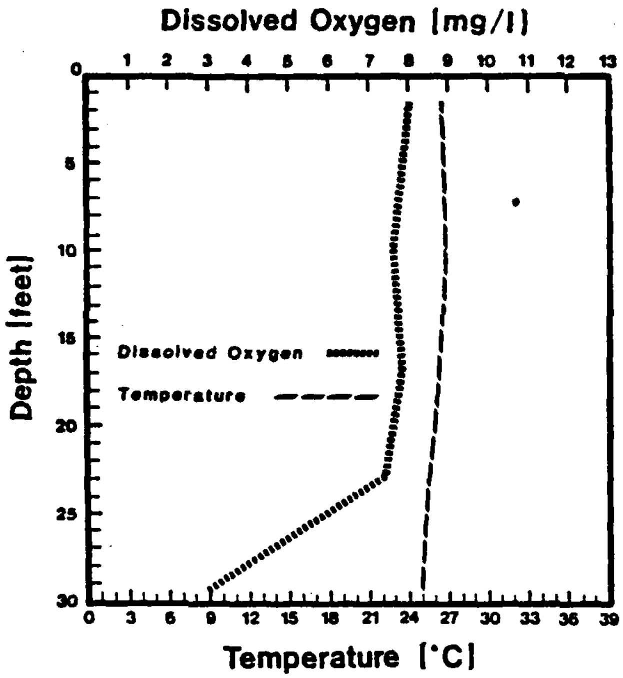
DEPTH (ft.)	DEPTH (m)	D.O. (mg/l)	TEMP. (°C)
1.6	0.5	9.5	26.5
9.8	2.5	8.0	26.0
16.4	5.0	7.9	26.0
23.0	7.0	7.1	26.0
29.5	9.0	3.9	21.5
36.1	11.0	0.4	16.0
42.6	13.0	0.1	13.0
49.2	15.0	0.0	12.0

Secchi Disk Transparency 15.7 ft. (4.8 m)

JOHNS POND, Mashpee / Cape Cod Drainage Area

Figure 82B DISSOLVED OXYGEN & TEMPERATURE PROFILES

13 August 1980



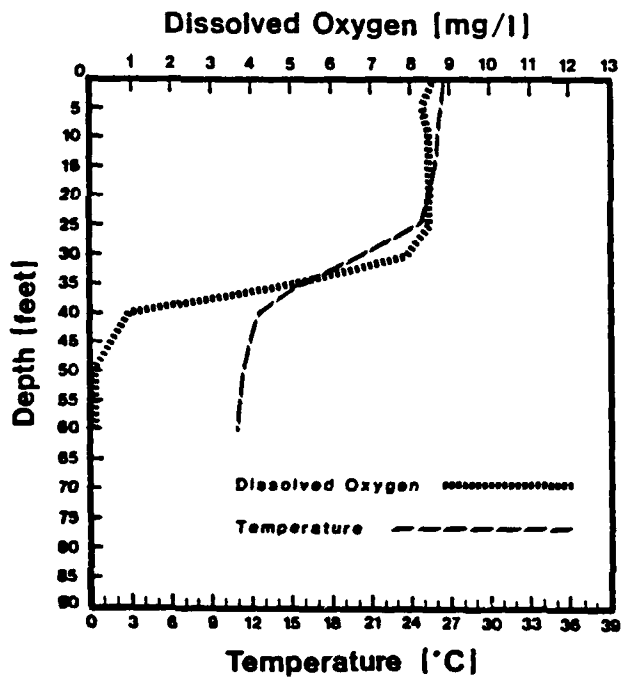
STATION 2

DEPTH (ft.)	(m)	D.O. (mg/l)	TEMP. (°C)
1.6	0.5	8.0	26.5
9.8	2.5	7.6	26.5
16.4	5.0	7.9	26.0
23.0	7.0	7.4	25.5
29.5	9.0	3.0	25.0

Secchi Disk Transparency 11.8 ft. (3.4 m)

Figure 82C DISSOLVED OXYGEN & TEMPERATURE PROFILES

17 AUGUST 1978



STATION 1

DEPTH (ft.)	(m)	D.O. (mg/l	TEMP. (°C)
0	0.0	8.6	26.5
5	1.5	8.3	26.5
10	3.0	8.4	26.0
15	4.6	8.4	26.0
20	6.1	8.4	25.5
25	7.6	8.4	25.0
30	9.1	7.9	21.0
35	10.7	5.1	16.0
40	12.2	1.0	13.0
45	13.4	0.4	12.0
50	15.2	0.0	11.5
55	16.8	0.0	11.0
60	18.3	0.0	11.0

Secchi Disk Transparency 18 ft. (5.5 m)

TABLE 58

JOHNS POND

MORPHOMETRIC DATA

Maximum Length	2,092 m	(6,864 ft)
Maximum Effective Length	2,092 m	(6,864 ft)
Maximum Width	644 m	(2,112 ft)
Maximum Effective Width	644 m	(2,112 ft)
Maximum Depth	19 m	(62 ft)
Mean Depth	5.9 m	(19.4 ft)
Mean Width	644 m	(2,112 ft)
Area	131 ha	(323 acres)
Volume	7,780,000 m^3	(6300 acre-ft)
Shoreline	7.0 km	(4.3 miles)
Development of Shoreline	1.73	
Development of Volume	0.93	
Mean to Maximum Depth Ratio	0.31	

TABLE 59a

JOHNS POND

STATION 1 (composite)

PHYTOPLANKTON ENUMERATION

17 August 1978

ORGANISM		Cells/ml
Bacillariophyceae (Diatoms)		
Unidentified	72	
Subtotal		72
Total		72

TABLE 59b

JOHNS POND

STATION 1 (composite)

PHYTOPLANKTON ENUMERATION

13 August 1980

ORGANISM		Cells/ml
Bacillariophyceae (Diatoms)		
Synedra sp.	14	
Tabellaria sp.	14	
Subtotal		28
Cyanophyceae (Blue-Greens)		
Sphaerocystis sp.	42	
Unidentified	14	
Subtotal		56
Chlorophyceae (Greens)		
Cryptomonas sp.	14	
Subtotal		14
Chrysophyceae (Golden-Browns)		
Mallomonas sp.	14	
Unidentified	28	
Subtotal		42
Dinophyceae (Dinoflagellates)		
Peridinium sp.	28	
Subtotal		28
Total		168

TABLE F-3
SUMMARY OF MMR WATER SUPPLY ANALYSES
FOR VOLATILE ORGANICS

Note: STONE = Stone School Water Supply
LYLE = Lyle School Water Supply
OTIS = Otis Memorial School Water Supply
FAL.AC = Falmouth Academy Water Supply

Source: ANGSC/SGB 1986

MMR SAMPLING PROGRAM SUMMARY^ (in ppb)
(08 Nov 85 - 03 Jun 86)

CONTAMINANT		"G" WELL	"J" WELL	STONE	LYLE	OTIS	FAL/AC
TETRACHLOROETHYLENE*							
(PCE)	HIGH	42.0	3.8	3.6*	4.0*	5.0*	4.0
	LOW	0.0	0.0	0.0	0.0	0.0	0.0
	MEAN	17.69	0.57	0.56	0.57	0.80	0.66
	STD.DEV	10.70	1.12	1.13	1.11	1.63	1.40
TRICHLOROETHYLENE							
(TCE)	HIGH	4.9	5.0	0.0	0.0	0.0	0.0
	LOW	0.0	0.0	0.0	0.0	0.0	0.0
	MEAN	0.39	0.33	0.0	0.0	0.0	0.0
	STD.DEV	1.24	1.22	0.0	0.0	0.0	0.0
TRICHLOROETHANE							
(TCA)	HIGH	22.0	2.1	2.1	0.0	1.6	1.3
	LOW	0.0	0.0	0.0	0.0	0.0	0.0
	MEAN	1.49	0.07	0.07	0.0	0.18	0.04
	STD.DEV	4.04	0.38	0.38	0.0	0.54	0.23
TOT TRIHALOMETHANES							
(TTHMs)	HIGH	15.3	3.1	17.4	16.2	15.5	18.7
	LOW	0.0	0.0	0.0	0.0	0.0	0.0
	MEAN	1.46	0.43	3.71	3.95	3.39	3.58
	STD.DEV	3.55	0.91	4.80	4.19	4.34	5.12
TRICHLOROFLUOROMETHANE							
(Freon 11)	HIGH	21.0	0.0	22.0#	28.0#	0.0	0.0
	LOW	0.0	0.0	0.0	0.0	0.0	0.0
	MEAN	1.91	0.0	0.73	0.93	0.0	0.0
	STD.DEV	4.84	0.0	3.95	5.03	0.0	0.0
DICHLORODIFLUOROMETHANE							
(Freon 12)	HIGH	16.0	0.0	0.0	0.0	0.0	0.0
	LOW	0.0	0.0	0.0	0.0	0.0	0.0
	MEAN	0.87	0.0	0.0	0.0	0.0	0.0
	STD.DEV	3.33	0.0	0.0	0.0	0.0	0.0

NOTES:
^ - Does not include individual THMs. Only covers their sum total upon which the standard is based.
* - Does not include anamolous results described in detail in the results table for Tetrachloroethylene (PCE).
\# - Suspected as being caused by maintenance activities at subject schools.

Applicable Standards: Maximum Contaminant Level {MCL} or Proposed MCL(PMCL):

1. PCE - 5.0 ppb (PMCL)
2. TCE - 5.0 ppb (PMCL)
3. TCA - 200 ppb (PMCL)
4. TTHM - 100 ppb (MCL)
5. Freon 11 - N/A
6. Freon 12 - N/A

Comment: Summary results after 30 sample sets of 6 samples per set, for a total of 180 samples.

TETRACHLOROETHYLENE (PCE) - (in ppb)

DATE	"G" WELL	"J" WELL	STONE	LYLE	OTIS	FAL/AC
85/11/08	ND	ND	1.9	ND	10.0*	ND
85/11/12	3.2	3.8	18.0*	19.0*	5.0	4.0
85/11/14	3.0	ND	9.8^	1.3	5.0	ND
85/11/18+	25.0	3.2¯	3.6¯	4.0¯	3.9¯	4.0¯
85/11/20+	28.0	2.0¯	3.6¯	3.0¯	3.8¯	4.0¯
85/11/22+	24.0	1.4¯	2.0¯	2.8¯	2.8¯	4.0¯
85/11/25+	2.0	ND	ND	ND	ND	ND
85/12/04+	3.9	ND	ND	ND	ND	1.4
85/12/10+	ND	ND	ND	ND	ND	ND
85/12/16+	21.0	ND	ND	1.4	ND	ND
86/01/07+	6.4	ND	ND	ND	ND	ND
86/01/14+	7.4	ND	ND	ND	ND	ND
86/01/21+	38.0	3.1¯	2.8¯	2.7¯	2.8¯	2.5¯
86/01/28+	13.0	1.7	ND	ND	ND	ND
86/02/04+	42.0	2.0	ND	ND	ND	ND
86/02/11+	13.0	ND	ND	ND	ND	ND
86/02/25+	18.0	ND	ND	ND	ND	ND
86/03/04+	19.0	ND	1.7	ND	ND	ND
86/03/11+	21.0	ND	ND	1.2	ND	ND
86/03/18+	26.0	ND	ND	ND	ND	ND
86/03/25+	23.0	ND	ND	ND	ND	ND
86/04/01+	30.0	ND	ND	ND	ND	ND
86/04/08+	17.0	ND	ND	ND	ND	ND
86/04/15+	19.0	ND	ND	ND	ND	ND
86/04/29+	17.0	ND	ND	ND	ND	ND
86/05/06+	18.0	ND	ND	ND	ND	ND
86/05/12+	19.0	ND	ND	ND	ND	ND
86/05/20+	27.0	ND	ND	ND	ND	ND
86/05/27+	26.0	ND	ND	ND	ND	ND
86/06/03+	21.0	ND	ND	ND	ND	ND

NOTES: * - These results are highly suspect as to their validity. Concentrations are far in excess of those found in the subject wells, and in the case of Otis school no PCE was detected in either "G" or "J" wells. In the case of Stone and Lyle schools, these concentrations coincide with levels of Freon 11 found in the schools on the same day. Suspect the Freon 11 and PCE were the result of maintenance activity and not due to well contamination.

^ - PCE level is three times greater than that found in well. Its validity is suspect.

¯ - These levels are suspected as being carry-over concentrations as a result of less than perfect purging of the GC column following the analysis for "G" well. Sequence of analysis prior to 86/02/25 was same as shown in above table from left to right. Beginning on 86/02/25 the sequence of analysis was reversed to preclude "G" Well carry-over.

\+ - "G" Well disconnected from Water Distribution System on 85/11/15 due to contamination levels. Since that date it has been used for sampling only!

ND - Signifies "None Detected"!

TRICHLOROFLUOROMETHANE (FREON 11) - (in ppb)

DATE	"G" WELL	"J" WELL	STONE	LYLE	OTIS	FAL/AC
85/11/08	ND	ND	ND	ND	ND	ND
85/11/12	ND	ND	22.0*	28.0*	ND	ND
85/11/14	ND	ND	ND	ND	ND	ND
85/11/18+	ND	ND	ND	ND	ND	ND
85/11/20+	ND	ND	ND	ND	ND	ND
85/11/22+	ND	ND	ND	ND	ND	ND
85/11/25+	ND	ND	ND	ND	ND	ND
85/12/04+	ND	ND	ND	ND	ND	ND
85/12/10+	ND	ND	ND	ND	ND	ND
85/12/16+	ND	ND	ND	ND	ND	ND
86/01/07+	ND	ND	ND	ND	ND	ND
86/01/14+	ND	ND	ND	ND	ND	ND
86/01/21+	21.0	ND	ND	ND	ND	ND
86/01/28+	ND	ND	ND	ND	ND	ND
86/02/04+	17.0	ND	ND	ND	ND	ND
86/02/11+	5.0	ND	ND	ND	ND	ND
86/02/25+	ND	ND	ND	ND	ND	ND
86/03/04+	5.1	ND	ND	ND	ND	ND
86/03/11+	1.6	ND	ND	ND	ND	ND
86/03/18+	4.1	ND	ND	ND	ND	ND
86/03/25+	ND	ND	ND	ND	ND	ND
86/04/01+	3.4	ND	ND	ND	ND	ND
86/04/08+	ND	ND	ND	ND	ND	ND
86/04/15+	ND	ND	ND	ND	ND	ND
86/04/29+	ND	ND	ND	ND	ND	ND
86/05/06+	ND	ND	ND	ND	ND	ND
86/05/12+	ND	ND	ND	ND	ND	ND
86/05/20+	ND	ND	ND	ND	ND	ND
86/05/27+	ND	ND	ND	ND	ND	ND
86/06/03+	ND	ND	ND	ND	ND	ND

NOTE: * - Samples results are suspected of being the result of maintenance activities at the two involved schools and not a result of well water contamination at the source!

+ - "G" Well disconnected from Water Distribution System on 85/11/15 due to contamination levels. Since that date it has been used for sampling only!

ND - Signifies "None Detected"!

TRICHLOROETHYLENE (TCE) - (in ppb)

DATE	"G" WELL	"J" WELL	STONE	LYLE	OTIS	FAL/AC
85/11/08	ND	ND	ND	ND	ND	ND
85/11/12	ND	ND	ND	ND	ND	ND
85/11/14	ND	ND	ND	ND	ND	ND
85/11/18+	4.8	5.0	ND	ND	ND	ND
85/11/20+	4.9	4.8	ND	ND	ND	ND
85/11/22+	2.0	ND	ND	ND	ND	ND
85/11/25+	ND	ND	ND	ND	ND	ND
85/12/04+	ND	ND	ND	ND	ND	ND
85/12/10+	ND	ND	ND	ND	ND	ND
85/12/16+	ND	ND	ND	ND	ND	ND
86/01/07+	ND	ND	ND	ND	ND	ND
86/01/14+	ND	ND	ND	ND	ND	ND
86/01/21+	ND	ND	ND	ND	ND	ND
86/01/28+	ND	ND	ND	ND	ND	ND
86/02/04+	ND	ND	ND	ND	ND	ND
86/02/11+	ND	ND	ND	ND	ND	ND
86/02/25+	ND	ND	ND	ND	ND	ND
86/03/04+	ND	ND	ND	ND	ND	ND
86/03/11+	ND	ND	ND	ND	ND	ND
86/03/18+	ND	ND	ND	ND	ND	ND
86/03/25+	ND	ND	ND	ND	ND	ND
86/04/01+	ND	ND	ND	ND	ND	ND
86/04/08+	ND	ND	ND	ND	ND	ND
86/04/15+	ND	ND	ND	ND	ND	ND
86/04/29+	ND	ND	ND	ND	ND	ND
86/05/06+	ND	ND	ND	ND	ND	ND
86/05/12+	ND	ND	ND	ND	ND	ND
86/05/20+	ND	ND	ND	ND	ND	ND
86/05/27+	ND	ND	ND	ND	ND	ND
86/06/03+	ND	ND	ND	ND	ND	ND

NOTES: + - "G" Well disconnected from Water Distribution System on 85/11/15 due to contamination levels. Since that date it has been used for sampling only!
ND - Signifies "None Detected"!

1,1,1-TRICHLOROETHANE (TCA) - (in ppb)

DATE	"G" WELL	"J" WELL	STONE	LYLE	OTIS	FAL/AC
85/11/08	ND	ND	ND	ND	1.6	ND
85/11/12	ND	ND	ND	ND	1.4	1.3
85/11/14	ND	ND	2.1	ND	2.3	ND
85/11/18+	4.8	2.1	ND	ND	ND	ND
85/11/20+	3.1	ND	ND	ND	ND	ND
85/11/22+	3.2	ND	ND	ND	ND	ND
85/11/25+	ND	ND	ND	ND	ND	ND
85/12/04+	22.0	ND	ND	ND	ND	ND
85/12/10+	ND	ND	ND	ND	ND	ND
85/12/16+	3.1	ND	ND	ND	ND	ND
86/01/07+	ND	ND	ND	ND	ND	ND
86/01/14+	ND	ND	ND	ND	ND	ND
86/01/21+	3.1	ND	ND	ND	ND	ND
86/01/28+	ND	ND	ND	ND	ND	ND
86/02/04+	2.2	ND	ND	ND	ND	ND
86/02/11+	ND	ND	ND	ND	ND	ND
86/02/25+	ND	ND	ND	ND	ND	ND
86/03/04+	ND	ND	ND	ND	ND	ND
86/03/11+	ND	ND	ND	ND	ND	ND
86/03/18+	ND	ND	ND	ND	ND	ND
86/03/25+	ND	ND	ND	ND	ND	ND
86/04/01+	ND	ND	ND	ND	ND	ND
86/04/08+	ND	ND	ND	ND	ND	ND
86/04/15+	ND	ND	ND	ND	ND	ND
86/04/29+	ND	ND	ND	ND	ND	ND
86/05/06+	ND	ND	ND	ND	ND	ND
86/05/12+	ND	ND	ND	ND	ND	ND
86/05/20+	1.7	ND	ND	ND	ND	ND
86/05/27+	1.5	ND	ND	ND	ND	ND
86/06/03+	ND	ND	ND	ND	ND	ND

NOTES: + - "G" Well disconnected from Water Distribution System on 85/11/15 due to contamination levels. Since that date it has been used for sampling only!
ND - Signifies "None Detected"!

BROMODICHLOROMETHANE (THM) - (in ppb)

DATE	"G" WELL	"J" WELL	STONE	LYLE	OTIS	FAL/AC
85/11/08	ND	ND	ND	ND	ND	ND
85/11/12	ND	ND	1.6	1.5	ND	1.8
85/11/14	ND	ND	ND	ND	2.2	ND
85/11/18+	ND	ND	5.1	5.1	4.9	4.6
85/11/20+	ND	ND	4.7	3.6	4.5	4.7
85/11/22+	ND	ND	4.9	4.1	4.0	4.7
85/11/25+	3.6	ND	2.0	2.5	2.3	ND
85/12/04+	ND	ND	ND	1.1	ND	3.3
85/12/10+	ND	ND	ND	1.2	1.3	1.4
85/11/16+	ND	ND	ND	3.2	1.4	1.3
86/01/07+	ND	ND	1.4	1.1	1.9	ND
86/01/14+	ND	ND	ND	1.3	1.2	1.4
86/01/21+	ND	ND	3.8	4.8	3.8	4.0
86/01/28+	13.0	1.7	ND	1.4	1.3	1.4
86/02/04+	ND	ND	3.0	2.2	ND	1.4
86/02/11+	ND	ND	ND	ND	1.4	ND
86/02/25+	ND	ND	ND	ND	ND	ND
86/03/04+	ND	ND	2.1	ND	ND	ND
86/03/11+	ND	ND	ND	1.1	ND	ND
86/03/18+	ND	ND	ND	ND	ND	ND
86/03/25+	ND	ND	ND	ND	ND	ND
86/04/01+	ND	ND	ND	ND	ND	ND
86/04/08+	ND	ND	ND	ND	ND	ND
86/04/15+	ND	ND	ND	ND	ND	ND
86/04/29+	ND	ND	ND	ND	ND	ND
86/05/06+	ND	ND	ND	ND	ND	ND
86/05/12+	ND	ND	ND	ND	ND	ND
86/05/20+	ND	ND	1.9	1.7	1.7	1.6
86/05/27+	ND	ND	1.5	1.6	1.5	1.6
86/06/03+	ND	ND	2.0	2.0	1.7	1.6

NOTES: + - "G" Well disconnected from Water Distribution System on 85/11/15 due to contamination levels. Since that date it has been used for sampling only!
ND - Signifies "None Detected"!

BROMOFORM (THM) - (in ppb)

DATE	"G" WELL	"J" WELL	STONE	LYLE	OTIS	FAL/AC
85/11/08	ND	ND	ND	ND	ND	ND
85/11/12	ND	ND	ND	ND	ND	ND
85/11/14	ND	ND	ND	ND	ND	ND
85/11/18+	ND	ND	ND	ND	ND	ND
85/11/20+	ND	ND	ND	ND	ND	ND
85/11/22+	ND	ND	ND	ND	ND	ND
85/11/25+	1.6	ND	ND	ND	ND	ND
85/12/04+	ND	ND	ND	ND	ND	1.1
85/12/10+	ND	ND	ND	ND	ND	ND
85/12/16+	ND	ND	ND	ND	ND	ND
86/01/07+	ND	ND	ND	ND	ND	ND
86/01/14+	ND	ND	ND	ND	ND	ND
86/01/21+	ND	ND	ND	ND	ND	ND
86/01/28+	ND	ND	ND	ND	ND	ND
86/02/04+	ND	ND	ND	ND	ND	ND
86/02/11+	ND	ND	ND	ND	ND	ND
86/02/25+	ND	ND	ND	ND	ND	ND
86/03/04+	ND	ND	ND	ND	ND	ND
86/03/11+	ND	ND	ND	ND	ND	ND
86/03/18+	ND	ND	ND	ND	ND	ND
86/03/25+	ND	ND	ND	ND	ND	ND
86/04/01+	ND	ND	ND	ND	ND	ND
86/04/08+	ND	ND	ND	ND	ND	ND
86/04/15+	ND	ND	ND	ND	ND	ND
86/04/29+	ND	ND	ND	ND	ND	ND
86/05/06+	ND	ND	ND	ND	ND	ND
86/05/12+	ND	ND	ND	ND	ND	ND
86/05/20+	ND	ND	ND	ND	ND	ND
86/05/27+	ND	ND	ND	ND	ND	ND
86/06/03+	ND	ND	ND	ND	ND	ND

NOTES: + - "G" Well disconnected from Water Distribution System on 85/11/15 due to contamination levels. Since that time it has been used for sampling only!

ND - Signifies "None Detected"!

CHLOROFORM (THM) - (in ppb)

DATE	"G" WELL	"J" WELL	STONE	LYLE	OTIS	PAL/AC
85/11/08	ND	ND	ND	5.0	ND	ND
85/11/12	ND	ND	4.0	1.8	ND	ND
85/11/14	ND	ND	ND	ND	3.5	ND
85/11/18+	2.5	3.1	5.1	5.3	6.0	6.1
85/11/20+	2.2	2.0	1.4	2.0	2.8	5.0
85/11/22+	3.4	1.4	2.8	4.2	4.2	5.1
85/11/25+	5.9	ND	ND	3.8	2.9	1.9
85/12/04+	3.2	ND	ND	1.9	ND	2.1
85/12/10+	ND	ND	ND	ND	ND	ND
85/12/16+	1.2	ND	ND	1.9	ND	ND
86/01/07+	ND	ND	ND	ND	ND	ND
86/01/14+	ND	ND	ND	[illegible]	ND	ND
86/01/21+	ND	ND	2.0	2.2	2.2	2.0
86/01/28+	ND	ND	1.5	1.5	1.3	1.4
86/02/04+	ND	3.0	1.4	1.2	ND	ND
86/02/11+	ND	ND	1.2	1.3	1.3	1.3
86/02/25+	ND	ND	ND	ND	ND	ND
86/03/04+	ND	ND	1.4	ND	ND	ND
86/03/11+	ND	ND	ND	1.1	ND	ND
86/03/18+	ND	ND	1.7	1.4	1.4	1.5
86/03/25+	ND	ND	ND	ND	ND	ND
86/04/01+	ND	ND	1.2	ND	ND	ND
86/04/08+	ND	ND	1.9	1.7	1.6	1.3
86/04/15+	1.7	1.8	3.0	3.1	3.4	3.1
86/04/29+	ND	ND	ND	ND	ND	ND
86/05/06+	ND	ND	ND	ND	ND	ND
86/05/12+	ND	ND	ND	ND	ND	ND
86/05/20+	ND	ND	1.3	1.7	2.4	ND
86/05/27+	1.4	ND	2.0	2.0	2.1	2.2
86/06/03+	ND	ND	1.9	1.8	1.3	1.4

NOTES: + - "G" Well disconnected from Water Distribution System on 85/11/15 due to contamination levels. Since that date it has been used for sampling only!

ND - Signifies "None Detected"!

DIBROMOCHLOROMETHANE (THM) - (in ppb)

DATE	"G" WELL	"J" WELL	STONE	LYLE	OTIS	FAL/AC
85/11/08	ND	ND	ND	ND	ND	ND
85/11/12	ND	ND	ND	ND	ND	ND
85/11/14	ND	ND	ND	ND	ND	ND
85/11/18+	ND	ND	7.2	5.8	4.6	4.2
85/11/20+	ND	ND	6.7	4.9	5.7	9.0
85/11/22+	ND	ND	9.0	4.5	4.5	6.8
85/11/25+	4.2	ND	2.4	3.3	3.1	1.2
85/12/04+	ND	ND	ND	1.2	ND	3.7
85/12/10+	ND	ND	ND	ND	ND	ND
85/12/16+	ND	ND	ND	ND	ND	ND
86/01/07+	ND	ND	ND	ND	ND	ND
86/01/14+	ND	ND	ND	ND	ND	ND
86/01/21+	ND	ND	4.3	3.5	3.3	3.5
86/01/28+	ND	ND	2.2	1.5	1.3	1.4
86/02/04+	ND	ND	1.4	1.8	ND	1.3
86/02/11+	ND	ND	ND	ND	ND	ND
86/02/25+	ND	ND	ND	ND	ND	ND
86/03/04+	ND	ND	ND	ND	ND	ND
86/03/11+	ND	ND	ND	ND	ND	ND
86/03/18+	ND	ND	ND	ND	ND	ND
86/03/25+	ND	ND	ND	ND	ND	ND
86/04/01+	ND	ND	ND	ND	ND	ND
86/04/08+	ND	ND	1.7	1.1	1.4	ND
86/04/15+	ND	ND	ND	ND	ND	ND
86/04/29+	ND	ND	ND	ND	ND	ND
86/05/06+	ND	ND	ND	ND	ND	ND
86/05/12+	ND	ND	ND	ND	ND	ND
86/05/20+	ND	ND	2.5	2.4	2.4	2.3
86/05/27+	ND	ND	2.1	2.1	2.0	1.9
86/06/03+	ND	ND	1.9	2.1	1.8	1.7

NOTES: + - "G" Well disconnected from Water Distribution System on 85/11/15 due to contamination levels. Since that date it has been used for sampling only!
ND - Signifies "None Detected"!

TOTAL TRIHALOMETHANES (TTHMs) - (in ppb)

DATE	"G" WELL	"J" WELL	STONE	LYLE	OTIS	FAL/AC
85/11/08	ND	ND	ND	5.0	ND	ND
85/11/12	ND	ND	5.6	3.3	ND	1.8
85/11/14	ND	ND	ND	ND	5.7	ND
85/11/18+	2.5	3.1	17.4	16.2	15.5	14.9
85/11/20+	2.2	2.0	12.8	10.5	13.0	18.7
85/11/22+	3.4	1.4	16.7	12.8	12.7	16.6
85/11/25+	15.3	ND	4.4	9.6	8.3	3.1
85/12/04+	3.2	ND	ND	4.2	ND	10.2
85/12/10+	ND	ND	ND	1.2	1.3	1.4
85/12/16+	1.2	ND	ND	5.1	1.4	1.3
86/01/07+	ND	ND	1.4	1.1	1.9	ND
86/01/14+	ND	ND	ND	1.3	1.2	1.4
86/01/21+	ND	ND	10.1	10.5	9.3	9.5
86/01/28+	13.0	1.7	3.7	4.4	3.9	4.2
86/02/04+	ND	3.0	5.8	5.2	ND	2.7
86/02/11+	ND	ND	1.2	1.3	2.7	1.3
86/02/25+	ND	ND	ND	ND	ND	ND
86/03/04+	ND	ND	5.6	ND	ND	ND
86/03/11+	ND	ND	ND	2.2	ND	ND
86/03/18+	ND	ND	1.7	1.4	1.4	1.5
86/03/25+	ND	ND	ND	ND	ND	ND
86/04/01+	ND	ND	1.2	ND	ND	ND
86/04/08+	ND	ND	3.6	2.8	3.0	1.3
86/04/15+	1.7	1.8	3.0	3.1	3.4	3.1
86/04/29+	ND	ND	ND	ND	ND	ND
86/05/06+	ND	ND	ND	ND	ND	ND
86/05/12+	ND	ND	ND	ND	ND	ND
86/05/20+	ND	ND	5.7	5.8	6.5	3.9
86/05/27+	1.4	ND	5.6	5.7	5.6	5.7
86/06/03+	ND	ND	5.8	5.9	4.8	4.7

NOTES: + - "G" Well disconnected from Water Distribution System on 85/11/15 due to contamination levels. Since that date it has been used for sampling only!
ND - Signifies "None Detected"!

DICHLORODIFLUOROMETHANE (FREON 12) - (in ppb)

DATE	"G" WELL	"J" WELL	STONE	LYLE	OTIS	FAL/AC
85/11/08	ND	ND	ND	ND	ND	ND
85/11/12	ND	ND	ND	ND	ND	ND
85/11/14	ND	ND	ND	ND	ND	ND
85/11/18+	ND	ND	ND	ND	ND	ND
85/11/20+	ND	ND	ND	ND	ND	ND
85/11/22+	ND	ND	ND	ND	ND	ND
85/11/25+	ND	ND	ND	ND	ND	ND
85/12/04+	ND	ND	ND	ND	ND	ND
85/12/10+	ND	ND	ND	ND	ND	ND
85/12/16+	ND	ND	ND	ND	ND	ND
86/01/07+	ND	ND	ND	ND	ND	ND
86/01/14+	ND	ND	ND	ND	ND	ND
86/01 21+	10.0	ND	ND	ND	ND	ND
86/01/28+	ND	ND	ND	ND	ND	ND
86/02/04+	16.0	ND	ND	ND	ND	ND
86/02/11+	ND	ND	ND	ND	ND	ND
86/02/25+	ND	ND	ND	ND	ND	ND
86/03/04+	ND	ND	ND	ND	ND	ND
86/03/11+	ND	ND	ND	ND	ND	ND
86/03/18+	ND	ND	ND	ND	ND	ND
86/03/25+	ND	ND	ND	ND	ND	ND
86/04/01+	ND	ND	ND	ND	ND	ND
86/04/08+	ND	ND	ND	ND	ND	ND
86/04/15+	ND	ND	ND	ND	ND	ND
86/04/29+	ND	ND	ND	ND	ND	ND
86/05/06+	ND	ND	ND	ND	ND	ND
86/05/12+	ND	ND	ND	ND	ND	ND
86/05/20+	ND	ND	ND	ND	ND	ND
86/05/27+	ND	ND	ND	ND	ND	ND
86/06/03+	ND	ND	ND	ND	ND	ND

NOTES: + - "G" Well disconnected from Water Distribution System on 85/11/15 due to contamination levels. Since that date it has been used for sampling only!

ND - Signifies "None Detected"!

DICHLORODIFLUOROMETHANE (FREON 12) - (in ppb)

DATE	"G" WELL	"J" WELL	STONE	LYLE	OTIS	FAL/AC
85/11/08	ND	ND	ND	ND	ND	ND
85/11/12	ND	ND	ND	ND	ND	ND
85/11/14	ND	ND	ND	ND	ND	ND
85/11/18+	ND	ND	ND	ND	ND	ND
85/11/20+	ND	ND	ND	ND	ND	ND
85/11/22+	ND	ND	ND	ND	ND	ND
85/11/25+	ND	ND	ND	ND	ND	ND
85/12/04+	ND	ND	ND	ND	ND	ND
85/12/10+	ND	ND	ND	ND	ND	ND
85/12/16+	ND	ND	ND	ND	ND	ND
86/01/07+	ND	ND	ND	ND	ND	ND
86/01/14+	ND	ND	ND	ND	ND	ND
86/01 21+	10.0	ND	ND	ND	ND	ND
86/01/28+	ND	ND	ND	ND	ND	ND
86/02/04+	16.0	ND	ND	ND	ND	ND
86/02/11+	ND	ND	ND	ND	ND	ND
86/02/25+	ND	ND	ND	ND	ND	ND
86/03/04+	ND	ND	ND	ND	ND	ND
86/03/11+	ND	ND	ND	ND	ND	ND
86/03/18+	ND	ND	ND	ND	ND	ND
86/03/25+	ND	ND	ND	ND	ND	ND
86/04/01+	ND	ND	ND	ND	ND	ND
86/04/08+	ND	ND	ND	ND	ND	ND
86/04/15+	ND	ND	ND	ND	ND	ND
86/04/29+	ND	ND	ND	ND	ND	ND
86/05/06+	ND	ND	ND	ND	ND	ND
86/05/12+	ND	ND	ND	ND	ND	ND
86/05/20+	ND	ND	ND	ND	ND	ND
86/05/27+	ND	ND	ND	ND	ND	ND
86/06/03+	ND	ND	ND	ND	ND	ND

NOTES: + - "G" Well disconnected from Water Distribution System on 85/11/15 due to contamination levels. Since that date it has been used for sampling only!
ND - Signifies "None Detected"!

O.E.H.L. TEST RESULTS OF SAMPLES FROM WATER SUPPLY WELLS AND DISTRIBUTION SYSTEM OTIS ANG BASE, MASS.

(Samples taken 13 November 1985)

Parameter	"J" Well	"G" Well	"B" Well	Lab Bldg. 169	Unit of Measure
Fluoride	< .1	< .1	< .1	.8	mg/L
Surfactants MBAS	< .1	< .1	< .1	< .1	mg/L
Residue, Flammable (TDS)	71	55	36	70	mg/L
Alkalin, Phenolth	0	0	0	0	mg/L
Alkalinity, Total	13	19	15	19	mg/L
Chloride	8	8	12	8	mg/L
Specific Conductance	90	79	67	112	umhos
Sulfate	17	4	7	13	mg/L
Alkanity Bicarbonate	13	19	15	19	mg/L
Color	< 5	< 5	< 5	< 5	mg/L
Silica	9.0	5.5	8	10	mg/L
Carbon Dioxide	—	—	—	—	—
Arsenic	< 10	< 10	< 10	< 10	ug/L
Barium	<200	<200	<200	<200	ug/L
Cadmium	< 10	< 10	< 10	< 10	ug/L
Chromium	< 50	< 50	< 50	< 50	ug/L
Lead	< 20	< 20	< 20	< 20	ug/L
Mercury	< 1	< 1	< 1	< 1	ug/L
Selenium	< 10	< 10	< 10	< 10	ug/L
Silver	< 10	< 10	< 10	< 10	ug/L
Copper	156	157	< 20	213	ug/L
Iron	<100	<100	<100	158	ug/L
Manganese	< 50	< 50	< 50	< 50	ug/L
Zinc	< 50	< 50	< 50	< 50	ug/L
Calcium	4.8	3.7	1.9	6.4	mg/L
Magnesium	3.8	2.3	1.1	3.7	mg/L
Potassium	1.2	.8	0.7	1.2	mg/L
Sodium	5.6	8.5	10.2	16.1	mg/L
Hardness	28	19	9	31	mg/L
Phosphorus, Total	< 11	.13	< .1	—	mg/L
Orthophosphate	< .1	< .1	< .1	—	mg/L
Oil and Grease (Fuel Screen)	< .3	< .3	.3	—	mg/L
Nitrate as N	.7	.3	.1	1.0	mg/L
Chromium	—	< 50	—	—	

D15

Volatile Halocarbons	"J" Well Nov 12	"J" Well Nov 13	"J" Well Nov 14	"J" Well Nov 18	"G" Well Nov 12	"G" Well Nov 13	"G" Well Nov 14	"G" Well Nov 18	"B" Well Nov 13	Unit of Measure
Carbon Tetrachloride	—	—	—	—	—	1.2	—	[illegible]	—	
		—				1.3			—	ug/L
Chloroform	—	—	—	3.1	—	0.6	—	2.5	0.4	ng/L
			—			0.8			0.7	ug/L
1,2 Dichloroethane	—	—	—	—	—	0.6	—		0.6	ug/L
		—				—			—	ug/L
Methylene Chloride	—	—	—	—	—	Trce	—		—	ug/L
		—				—				ug/L
Tetrachloroethylene	3.8	1.0	3.0	3.2	3.2	9.7	—	25.0	0.2	ug/L
		0.9				9.5	—			ug/L
1-1-1 Trichloroethane	—	—	—	2.1	—	0.6	—	4.8	—	ug/L
		—				0.6			—	ug/L
Trichloroethylene	—	—	—	5.0	—	0.6		4.8	—	ug/L
		—				0.5			—	ug/L

Notes: 1. 12-14-18 Nov 85 by Contract Lab
13 Nov 85 by OEHL.

2. Well "G" off line 15 Nov 85.

TABLE F-4
VOLATILE ORGANIC COMPOUNDS IN USGS
WELLS SOUTH OF MMR

SOURCE: LeBlanc (1984)

Table 9. Organic analyses by purge/trap and gas chromatography and mass spectrometry for samples from 1983 field season.

Well	Compound	Concentration µg/l
FSW		
166-67	Trichloroethene	0.3
	Tetrachloroethene	0.2
182-69	Not Found	
194-57	Trichloroethene	5.0
	Tetrachloroethene	7.0
232-58	1,1,1-Trichloroethane	0.2
	Tetrachlorethene	0.1
233-67	1,1,1-Trichloroethane	0.5
	Trichloroethene	4.4
	Tetrachloroethene	5.1
	1,1-Dichloroethane	0.1
	Trans-1,2-dichloroethene	1.6
236-106	Trichloroethene	0.1
	Tetrachloroethene	0.9
237-88	Trichloroethene	0.1
	Tetrachloroethene	0.7
239-64	1,1,1-Trichloroethane	0.1
	Trichloroethene	95.0
	Tetrachloroethene	134.0
	Trans-1,2-dichloroethene	34.0
	1,1-Dichloroethane	5.0
	1,1-Dichloroethene	0.2
	1,2-Dichloroethane	0.2
	Carbontetrachloride	0.1
	1,2-Dichloropropane	0.2
	1,1,2-Trichloroethane	0.1
	Chlorobenzene	0.2
240-95	1,1,1-Trichloroethane	0.2
241-98	1,1,1-Trichloroethane	1.4
242-77	Not Found	

Table 9 Continued. Organic compounds from purge/trap and gas chromatography and mass spectrometry for samples from the 1983 field season.

Well	Compound	Concentration µg/l
FSW		
244-90	1,1,1-Trichloroethane	0.5
	Trichloroethene	30.0
	Tetrachloroethene	245.0
	Trans-1,2-dichloroethane	113.0
	1,2-Dichloroethane	0.6
	Carbontetrachloride	0.2
	1,2-Dichloropropane	0.3
	1,1,2-Trichloroethane	0.1
	Chlorobenzene	0.3
	Ethylbenzene	0.2
254-216	Trichloroethene	0.3
	Tetrachloroethene	0.7
254-168	Trichloroethene	0.3
	Tetrachloroethene	0.7
	1,2-Transdichloroethene	0.3
254-140	Trichloroethene	4.5
254-107	1,1,1-Trichloroethane	2.8
	Trichloroethene	48.0
	Tetrachloroethene	16.0
	1,1-Dichloroethane	1.0
	1,2-Transdichloroethene	26.0
254-72	Trichloroethene	65.0
	Tetrachloroethene	417.0
	1,1-Dichloroethane13.3	
	1,2-Transdichloroethene	197.0
254-54	Trichloroethene	1.4
	Tetrachloroethene	3.6
	1,2-Transdichloroethane	3.0
254-26	Not Found	—
262-85	1,1,1-Trichloroethane	2.0
	Trichloroethene	27.0
	Tetrachloroethene	14.0
	1,2-Transdichloroethene	5.0
262-69	Trichloroethene	1.9
	Tetrachloroethene	0.3
	1,2-Transdichloroethene	1.5

Table 9 Continued. Organic analyses by purge/trap and gas chromatography and mass spectrometry for samples from the 1983 field season.

Well	Compound	Concentration µg/l
FSW		
267-88	1,1,1-trichloroethane	2.5
	Trichloroethene	0.6
	Tetrachloroethene	6.2
	Carbontetrachloride	0.1
	1,1,2-Trichloroethane	0.1
	Chlorobenzene	0.1
271-141	Not Found	
271-85	Not Found	
271-41	Not Found	
247-70	Not Found	
282-94	1,1,1-Trichloroethane	1.1
	Trichloroethene	3.9
	Tetrachloroethene	0.1
282-70	Not Found	
288-97	1,1,1-Trichloroethane	1.0
	Trichloroethene	10.0
	Tetrachloroethene	19.0
294-89	Trichloroethene	0.4
299-20	Not Found	
300-30	Trichloroethene	2.1
	Tetrachloroethene	0.8
	Trans-1,2-dichloroethene	0.9
	Chlorobenzene	0.1
Tap Water Otis Air National Guard Base		
	1,1,1-Trichloroethane	0.3
	Chloroform	5.0
	Bromodichloromethane	9.9
	Dibromochloromethane	7.3
	Bromoform	1.0
Ashumet Pond Boat Landing		
Sample 1	Trans-1,2-dichloroethene	0.3
Sample 2	Trichloroethene	0.1
Sample 3	Not Found	
Sample 4	Not Found	

TABLE F-5
AEHA MONITORING WELL WATER QUALITY

SOURCE: Camp Edwards DFAE 1986

WATER QUALITY OF
AEHA WELLS
AT MMR

Well No.	Tetrachloro-ethylene (µg/L)	Trichloro-ethylene (µg/L)	Dichloro-fluoromethane (µg/L)	Toluene (µg/L)	Lead (mg/L)
AEHA-1	14	7	3	3	<0.10
AEHA-2	<3	<3	<3	<3	<0.10
AEHA-3	<3	<3	<3	<3	0.112
AEHA-4	<3	<3	<3	<3	<0.10
AEHA-5	<3	<3	<3	<3	<0.10
AEHA-6	<3	<3	<3	<3	<0.10
AEHA-7	<3	<3	<3	<3	<0.10
AEHA-8*	<3	<3	<3	<3	<0.005
AEHA-9*	<3	<3	<3	<3	<0.005
AEHA-1A*	<3	<3	<3	3	<0.005
BHW-27**	23	<3	<3	<3	<0.10

NOTE

Samples taken on July 19, 1985

* Samples taken on September 16, 1985
** Former water supply observation well sampled July 19, 1985

Source: AEHA Files

APPENDIX G
HAZARD ASSESSMENT RATING
METHODOLOGY CRITERIA

USAF INSTALLATION RESTORATION PROGRAM

HAZARD ASSESSMENT RATING METHODOLOGY

BACKGROUND

The Department of Defense (DOD) has established a comprehensive program to identify, evaluate, and control problems associated with past disposal practices at DOD facilities. One of the actions required under this program is to:

> "develop and maintain a priority listing of contaminated installations and facilities for remedial action based on potential hazard to public health, welfare, and environmental impacts." (Reference: DEQPPM 81-5, 11 December 1981).

Accordingly, the United States Air Force (USAF) has sought to establish a system to set priorities for taking further actions at sites based upon information gathered during the Records Search phase of its Installation Restoration Program (IRP).

The first site rating model was developed in June 1981 at a meeting with representatives from USAF Occupational Environmental Health Laboratory (OEHL), Air Force Engineering Services Center (AFESC), Engineering-Science (ES) and CH_2M Hill. The basis for this model was a system developed for EPA by JRB Associates of McLean, Virginia. The JRB model was modified to meet Air Force needs.

After using this model for 6 months at over 20 Air Force installations, certain inadequacies became apparent. Therefore, on January 26 and 27, 1982, representatives of USAF OEHL, AFESC, various major commands, Engineering Science, and CH_2M Hill met to address the inadequacies. The result of the meeting was a new site rating model designed to present a better picture of the hazards posed by sites at Air Force installations. The new rating model described in this presentation is referred to as the Hazard Assessment Rating Methodology.

PURPOSE

The purpose of the site rating model is to provide a relative ranking of sites of suspected contamination from hazardous substances. This model will assist the Air Force in setting priorities for follow-on site investigations and confirmation work under Phase II of IRP.

This rating system is used only after it has been determined that (1) potential for contamination exists (hazardous wastes present in sufficient quantity), and (2) potential for migration exists. A site can be deleted from consideration for rating on either basis.

DESCRIPTION OF MODEL

Like the other hazardous waste site ranking models, the U.S. Air Force's site rating model uses a scoring system to rank sites for priority attention. However, in developing this model, the designers incorporated some special features to meet specific DOD program needs.

The model uses data readily obtained during the Record Search portion (Phase I) of the IRP. Scoring judgments and computations are easily made. In assessing the hazards at a given site, the model develops a score based on the most likely routes of contamination and the worst hazards at the site. Sites are given low scores only if there are clearly no hazards at the site. This approach meshes well with the policy for evaluating and setting restrictions on excess DOD properties.

As with the previous model, this model considers four aspects of the hazard posed by a specific site: the possible receptors of the contamination, the waste and its characteristics, potential pathways for waste contaminant migration, and any efforts to contain the contaminants. Each of these categories contains a number of rating factors that are used in the overall hazard rating.

The receptors category rating is calculated by scoring each factor, multiplying by a factor weighting constant and adding the weighted scores to obtain a total category score.

The pathways category rating is based on evidence of contaminant migration or an evaluation of the highest potential (worst case) for contaminant migration along one of three pathways. If evidence of contaminant migration exists, the category is given a subscore of 80 to 100 points. For indirect evidence, 80 points are assigned and for direct evidence 100 points are assigned. If no evidence is found, the highest score among three possible routes is used. These routes are surface water migration, flooding, and ground-water migration. Evaluation of each route involves factors associated with the particular migration route. The three pathways are evaluated and the highest score among all four of the potential scores is used.

The waste characteristics category is scored in three steps. First, a point rating is assigned based on an assessment of the waste quantity and the hazard (worst case) associated with the site. The level of confidence in the information is also factored into the assessment. Next, the score is multiplied by a waste persistence factor, which acts to reduce the score if the waste is not very persistent. Finally, the score is further modified by the physical state of the waste. Liquid wastes receive the maximum score, while scores for sludges and solids are reduced.

The scores for each of the three categories are then added together and normalized to a maximum possible score of 100. Then the waste management practice category is scored. Sites at which there is no containment are not reduced in score. Scores for sites with limited containment can be reduced by 5 percent. If a site is contained and well managed, its score can be reduced by 90 percent. The final site score is calculated by applying the waste management practices category factor to the sum of the scores for the other three categories.

FIGURE 1

HAZARD ASSESSMENT RATING METHODOLOGY FLOW CHART

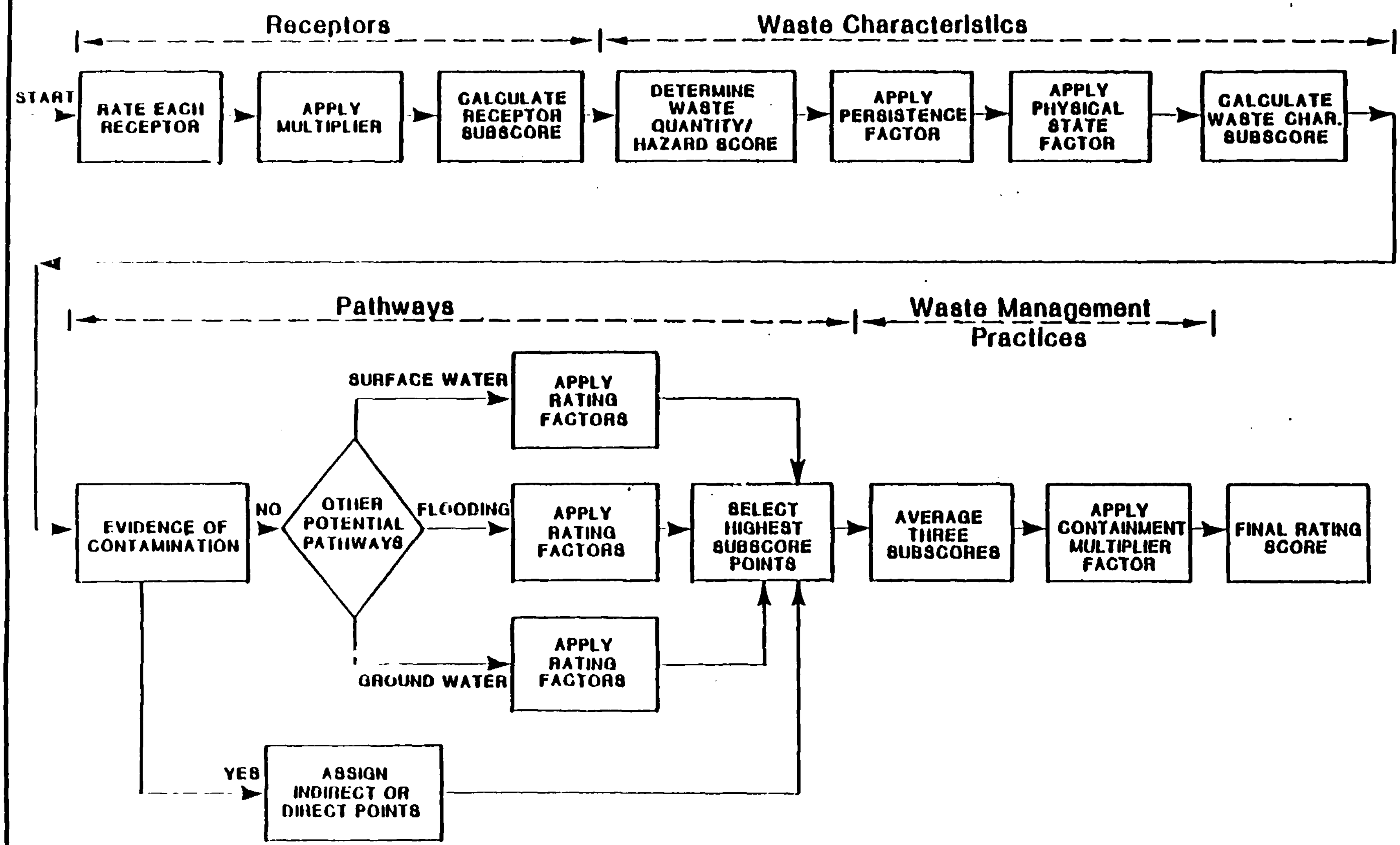


FIGURE 2

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE ______

LOCATION ______

DATE OF OPERATION OR OCCURRENCE ______

OWNER/OPERATOR ______

COMMENTS/DESCRIPTION ______

SITE RATED BY ______

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site		4		
B. Distance to nearest well		10		
C. Land use/zoning within 1 mile radius		3		
D. Distance to reservation boundary		6		
E. Critical environments within 1 mile radius of site		10		
F. Water quality of nearest surface water body		6		
G. Ground water use of uppermost aquifer		9		
H. Population served by surface water supply within 3 miles downstream of site		6		
I. Population served by ground-water supply within 3 miles of site		6		
		Subtotals	______	______

Receptors subscore (100 X factor score subtotal/maximum score subtotal) ______

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = Large) ______
2. Confidence level (C = confirmed, S = suspected) ______
3. Hazard rating (H = high, M = medium, L = low) ______

Factor Subscore A (from 20 to 100 based on factor score matrix) ______

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

______ X ______ = ______

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

______ X ______ = ______

FIGURE 2 (Continued)

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore ______

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water		8		
Net precipitation		6		
Surface erosion		8		
Surface permeability		6		
Rainfall intensity		8		

Subtotals ______ ______

Subscore (100 X factor score subtotal/maximum score subtotal) ______

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding		1		

Subscore (100 x factor score/3) ______

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water		8		
Net precipitation		6		
Soil permeability		8		
Subsurface flows		8		
Direct access to ground water		8		

Subtotals ______ ______

Subscore (100 x factor score subtotal/maximum score subtotal) ______

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore ______

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors ______
Waste Characteristics ______
Pathways ______

Total ______ divided by 3 = ______
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

______ X ______ = ______

TABLE 1

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

I. RECEPTORS CATEGORY

Rating Factors	Rating Scale Levels 0	1	2	3	Multiplier
A. Population within 1,000 feet (includes on-base facilities)	0	1 - 25	26 - 100	Greater than 100	4
B. Distance to nearest water well	Greater than 3 miles	1 to 3 miles	3,001 feet to 1 mile	0 to 3,000 feet	10
C. Land Use/Zoning (within 1 mile radius)	Completely remote (zoning not applicable)	Agricultural	Commercial or Industrial	Residential	3
D. Distance to installation boundary	Greater than 2 miles	1 to 2 miles	1,001 feet to 1 mile	0 to 1,000 feet	6
E. Critical environments (within 1 mile radius)	Not a critical environment	Natural areas	Pristine natural areas; minor wetlands; preserved areas; presence of economically important natural resources susceptible to contamination.	Major habitat of an endangered or threatened species; presence of recharge area; major wetlands.	10
F. Water quality/use designation of nearest surface water body	Agricultural or Industrial use.	Recreation, propagation and management of fish and wildlife.	Shellfish propagation and harvesting.	Potable water supplies	6
G. Ground-Water use of uppermost aquifer	Not used, other sources readily available.	Commercial, industrial, or irrigation, very limited other water sources.	Drinking water, municipal water available.	Drinking water, no municipal water available; commercial, industrial, or irrigation, no other water source available.	9
H. Population served by surface water supplies within 3 miles downstream of site	0	1 - 50	51 - 1,000	Greater than 1,000	6
I. Population served by aquifer supplies within 3 miles of site	0	1 - 50	51 - 1,000	Greater than 1, 000	6

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

II. WASTE CHARACTERISTICS

A-1 Hazardous Waste Quantity

S = Small quantity (<5 tons or 20 drums of liquid)
M = Moderate quantity (5 to 20 tons or 21 to 85 drums of liquid)
L = Large quantity (>20 tons or 85 drums of liquid)

A-2 Confidence Level of Information

C = Confirmed confidence level (minimum criteria below)

o Verbal reports from interviewer (at least 2) or written information from the records.

o Knowledge of types and quantities of wastes generated by shops and other areas on base.

o Based on the above, a determination of the types and quantities of waste disposed of at the site.

S = Suspected confidence level

o No verbal reports or conflicting verbal reports and no written information from the records.

o Logic based on a knowledge of the types and quantities of hazardous wastes generated at the base, and a history of past waste disposal practices indicate that these wastes were disposed of at a site.

A-3 Hazard Rating

Hazard Category	Rating Scale Levels 0	1	2	3
Toxicity	Sax's Level 0	Sax's Level 1	Sax's Level 2	Sax's Level 3
Ignitability	Flash point greater than 200°F	Flash point at 140°F to 200°F	Flash point at 80°F to 140°F	Flash point less than 80°F
Radioactivity	At or below background levels	1 to 3 times background levels	3 to 5 times background levels	Over 5 times background levels

Use the highest individual rating based on toxicity, ignitability and radioactivity and determine the hazard rating.

Hazard Rating	Points
High (H)	3
Medium (M)	2
Low (L)	1

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

II. WASTE CHARACTERISTICS (Continued)

Waste Characteristics Matrix

Point Rating	Hazardous Waste Quantity	Confidence Level of Information	Hazard Rating
100	L	C	H
80	L	C	M
	M	C	H
70	L	S	H
60	S	C	H
	M	C	M
50	L	S	M
	L	C	L
	M	S	M
	S	C	H
40	S	S	H
	M	S	M
	M	C	L
	L	S	L
30	S	C	L
	M	S	L
	S	S	M
20	S	S	L

Notes:

For a site with more than one hazardous waste, the waste quantities may be added using the following rules:

Confidence Level

- o Confirmed confidence levels (C) can be added
- o Suspected confidence levels (S) can be added
- o Confirmed confidence levels cannot be added with suspected confidence levels

Waste Hazard Rating

- o Wastes with the same hazard rating can be added
- o Wastes with different hazard ratings can only be added in a downgrade mode, e.g., MCM + SCH = LCM if the total quantity is greater than 20 tons.

Example: Several wastes may be present at a site, each having an MCM designation (60 points). By adding the quantities of each waste, the designation may change to LCM (80 points). In this case, the correct point rating for the waste is 80.

B. Persistence Multiplier for Point Rating

Persistence Criteria	Multiply Point Rating From Part A by the Following
Metals, polycyclic compounds, and halogenated hydrocarbons	1.0
Substituted and other ring compounds	0.9
Straight chain hydrocarbons	0.8
Easily biodegradable compounds	0.4

C. Physical State Multiplier

Physical State	Multiply Point Total From Parts A and B by the Following
Liquid	1.0
Sludge	0.75
Solid	0.50

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES,

III. PATHWAYS CATEGORY

A. Evidence of Contamination

Direct evidence is obtained from laboratory analyses of hazardous contaminants present above natural background levels in surface water, ground water, or air. Evidence should confirm that the source of contamination is the site being evaluated.

Indirect evidence might be from visual observation (i.e., leachate), vegetation stress, sludge deposits, presence of taste and odors in drinking water, or reported discharges that cannot be directly confirmed as resulting from the site, but the site is greatly suspected of being a source of contamination.

B-1 POTENTIAL FOR SURFACE WATER CONTAMINATION

Rating Factor	Rating Scale Levels 0	1	2	3	Multiplier
Distance to nearest surface water (includes drainage ditches and storm sewers)	Greater than 1 mile	2,001 feet to 1 mile	501 feet to 2,000 feet	0 to 500 feet	8
Net precipitation	Less than -10 in.	-10 to + 5 in.	+5 to +20 in.	Greater than +20 in.	6
Surface erosion	None	Slight	Moderate	Severe	8
Surface permeability	0% to 15% clay ($>10^{-2}$ cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	Greater than 50% clay ($<10^{-6}$ cm/sec)	6
Rainfall intensity based on 1 year 24-hr rainfall	<1.0 inch	1.0-2.0 inches	2.1-3.0 inches	>3.0 inches	8

B-2 POTENTIAL FOR FLOODING

Rating Factor	0	1	2	3	Multiplier
Floodplain	Beyond 100-year floodplain	In 25-year flood-plain	In 10-year flood-plain	Floods annually	1

B-3 POTENTIAL FOR GROUND-WATER CONTAMINATION

Rating Factor	0	1	2	3	Multiplier
Depth to ground water	Greater than 500 ft	50 to 500 feet	11 to 50 feet	0 to 10 feet	8
Net precipitation	Less than -10 in.	-10 to +5 in.	+5 to +20 in.	Greater than +20 in.	6
Soil permeability	Greater than 50% clay ($>10^{-6}$ cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	0% to 15% clay ($<10^{-2}$ cm/sec)	8
Subsurface flows	Bottom of site greater than 5 feet above high ground-water level	Bottom of site occasionally submerged	Bottom of site frequently submerged	Bottom of site located below mean ground-water level	8
Direct access to ground water (through faults, fractures, faulty well casings, subsurface features, etc.)	No evidence of risk	Low risk	Moderate risk	High risk	8

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

IV. WASTE MANAGEMENT PRACTICES CATEGORY

A. This category adjusts the total risk as determined from the receptors, pathways, and waste characteristics categories for waste management practices and engineering controls designed to reduce this risk. The total risk is determined by first averaging the receptors, pathways, and waste characteristics subscores.

B. WASTE MANAGEMENT PRACTICES FACTOR

The following multipliers are then applied to the total risk points (from A):

Waste Management Practice	Multiplier
No containment	1.0
Limited containment	0.95
Fully contained and in full compliance	0.10

Guidelines for fully contained:

Landfills:

- o Clay cap or other impermeable cover
- o Leachate collection system
- o Liners in good condition
- o Adequate monitoring wells

Surface Impoundments:

- o Liners in good condition
- o Sound dikes and adequate freeboard
- o Adequate monitoring wells

Spills:

- o Quick spill cleanup action taken
- o Contaminated soil removed
- o Soil and/or water samples confirm total cleanup of the spill

Fire Protection Training Areas:

- o Concrete surface and berms
- o Oil/water separator for pretreatment of runoff
- o Effluent from oil/water separator to treatment plant

General Note: If data are not available or known to be complete the factor ratings under items I-A through I, III-B-1 or III-B-3, then leave blank for calculation of factor score and maximum possible score.

APPENDIX H

HAZARD ASSESSMENT RATING
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HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: TRANSMITTER STATION (CS-1) COAST GUARD

Location: PARCEL 'P'

Date of Operation or Occurrence: 1969-present

Owner/Operator: COAST GUARD

Comments/Description: USED TCE, BURIED CAPACITORS

Site Rated By: LRH/ECJ

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1-mile radius	3	3	9	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1-mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by groundwater supply within 3 miles of site	3	6	18	18
SUBTOTALS			136	180
Receptors subscore (100 X factor score subtotal/maximum score subtotal)				75.6

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1 = small, 2 = medium, 3 = large) 2
2. Confidence level (1 = confirmed, 2 = suspected) 2
3. Hazard rating (1 = low, 2 = medium, 3 = high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

B. Apply persistence factor:

Factor Subscore A x Persistence Factor = Subscore B 50 x 1.0 = 50

C. Apply physical state multiplier:
Subscore B x Physical State Multiplier = Waste Characteristics Subscore 50 x 1.0 = 50

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists, proceed to C. If no evidence or indirect exists, proceed to B.

Subscore 80

B. Rate the migration potential for three potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface water migration				
Distance to nearest surface water	0	8	0	24
Net precipitation	3	6	18	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
SUBTOTALS			34	108
Subscore (100 x factor score subtotal/maximum score subtotal)				31.4
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Groundwater migration				
Depth to groundwater	1	8	8	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTALS			50	114
Subscore (100 x factor score subtotal/maximum score subtotal)				43.8

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above. Pathways Subscore 43.8

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	75.6
Waste Characteristics	50
Pathways	80
TOTAL	205.6 divided by 3 = 68.5 Gross total score

B. Apply factor for waste containment from waste management practices. Gross total score X waste management practices factor = final score.

68.5 x 1.0 = 68.5

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: __COAST_GUARD_AIR_STATION_-_HANGAR_#3170_(CS-2)____________

Location: ____Bldg._#3170,_Herbert_Road,_MMR____________________________

Date of Operation or Occurrence: __1970 - present______________________

Owner/Operator: __Steve_Kibner_-_Avionics_Officer______________________

Comments/Description: ____

Site Rated By: __LRH/ECJ____

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1-mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1-mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by groundwater supply within 3 miles of site	3	6	18	18
SUBTOTALS			150	180
Receptors subscore (100 X factor score subtotal/maximum score subtotal)				83.3

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1 = small, 2 = medium, 3 = large) ___3

2. Confidence level (1 = confirmed, 2 = suspected) ___2

3. Hazard rating (1 = low, 2 = medium, 3 = high) ___3

Factor Subscore A (from 20 to 100 based on factor score matrix) __70

B. Apply persistence factor:

Factor Subscore A x Persistence Factor = Subscore B __70 x _1.0 = __70

C. Apply physical state multiplier:
Subscore B x Physical State Multiplier = Waste Characteristics Subscore __70 x _1.0 = __70

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III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists, proceed to C. If no evidence or indirect exists, proceed to B.

Subscore ____

B. Rate the migration potential for three potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface water migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	3	6	18	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
SUBTOTALS			50	108
Subscore (100 x factor score subtotal/ maximum score subtotal)				46.2
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				—
3. Groundwater migration				
Depth to groundwater	1	8	8	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTALS			50	114
Subscore (100 x factor score sub-total/maximum score subtotal)				43.8

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above. Pathways Subscore 46.2

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors 83.3

Waste Characteristics 70

Pathways 46.2

TOTAL 199.5 divided by 3 = 66.5 Gross total score

B. Apply factor for waste containment from waste management practices. Gross total score X waste management practices factor = final score.

66.5 x 1.0 = 66.5

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: __CURRENT_BASE_SERVICE_STATION_(CS-3)

Location: __MASS._MILITARY_RESERVATION

Date of Operation or Occurrence: __1951 -_present

Owner/Operator: ___Air_Force_1951-1975___Coast_Guard_1975-1986

Comments/Description: __Leaking_Tank_and_Oily_Soil

Site Rated By: __J._Farry

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1-mile radius	3	3	9	9
D. Distance to reservation boundary	1	6	6	18
E. Critical environments within 1-mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by groundwater supply within 3 miles of site	3	6	18	18
SUBTOTALS			134	180
Receptors subscore (100 X factor score subtotal/maximum score subtotal)				74.4

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1 = small, 2 = medium, 3 = large) ___1

2. Confidence level (1 = confirmed, 2 = suspected) ___1

3. Hazard rating (1 = low, 2 = medium, 3 = high) ___3

Factor Subscore A (from 20 to 100 based on factor score matrix) __60

B. Apply persistence factor:

Factor Subscore A x Persistence Factor = Subscore B __60 x _1.0 = __60

C. Apply physical state multiplier:
Subscore B x Physical State Multiplier = Waste Characteristics Subscore __60 x _1.0 = __60

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III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists, proceed to C. If no evidence or indirect exists, proceed to B.

Subscore ___

B. Rate the migration potential for three potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. Surface water migration				
Distance to nearest surface water	1	8	8	24
Net precipitation	3	6	18	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
SUBTOTALS			42	108
Subscore (100 x factor score subtotal/maximum score subtotal)				38
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Groundwater migration				
Depth to groundwater	2	8	16	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTALS			58	114
Subscore (100 x factor score subtotal/maximum score subtotal)				51

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above. Pathways Subscore 51

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	74.4
Waste Characteristics	60
Pathways	51
TOTAL	185.4 divided by 3 = 61.8 Gross total score

B. Apply factor for waste containment from waste management practices. Gross total score X waste management practices factor = final score.

61.8 x 0.95 = 58.7

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: ___CG_HANGAR_#128_(CS-4)___

Location: __Bldg._#128,_Reilly_Street,_MMR___

Date of Operation or Occurrence: ___1976 - present___

Owner/Operator: ___Randal_Coyne_-_Metal_Shop___Coast_Guard___

Comments/Description: ___

Site Rated By: ___LRH/ECJ___

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1-mile radius	3	3	9	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1-mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by groundwater supply within 3 miles of site	3	6	18	18
SUBTOTALS			130	180
Receptors subscore (100 X factor score subtotal/maximum score subtotal)				72.2

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1 = small, 2 = medium, 3 = large) ___1

2. Confidence level (1 = confirmed, 2 = suspected) ___2

3. Hazard rating (1 = low, 2 = medium, 3 = high) ___3

Factor Subscore A (from 20 to 100 based on factor score matrix) __40

B. Apply persistence factor:

Factor Subscore A x Persistence Factor = Subscore B __40 x _0.9 = __36

C. Apply physical state multiplier:
Subscore B x Physical State Multiplier = Waste Characteristics Subscore __36 x _1.0 = __36

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III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists, proceed to C. If no evidence or indirect exists, proceed to B.

Subscore ____

B. Rate the migration potential for three potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface water migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	3	6	18	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
SUBTOTALS			58	108
Subscore (100 x factor score subtotal/maximum score subtotal)				53.7
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Groundwater migration				
Depth to groundwater	1	8	8	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTALS			50	114
Subscore (100 x factor score sub-total/maximum score subtotal)				43.8

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above. Pathways Subscore 53.7

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors 72.2

Waste Characteristics 36

Pathways 53.7

TOTAL 161.9 divided by 3 = 54.0 Gross total score

B. Apply factor for waste containment from waste management practices. Gross total score X waste management practices factor = final score.

54.0 x 1.0 = 54.0

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: __CG_MAINTENANCE_SHOPS_(CS-5)__________________

Location: MASS._MILITARY_RESERVATION__________________

Date of Operation or Occurrence: __________________

Owner/Operator: ___COAST_GUARD__________________

Comments/Description: __________________

Site Rated By: __________________

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1-mile radius	3	3	9	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1-mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by groundwater supply within 3 miles of site	3	6	18	18
SUBTOTALS			140	180
Receptors subscore (100 X factor score subtotal/maximum score subtotal)				77.7

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1 = small, 2 = medium, 3 = large) ___1
2. *Confidence level (1 = confirmed, 2 = suspected)* ___2
3. Hazard rating (1 = low, 2 = medium, 3 = high) ___3

Factor Subscore A (from 20 to 100 based on factor score matrix) ___40

B. Apply persistence factor:

Factor Subscore A x Persistence Factor = Subscore B ___40 x _1.0 = ___40

C. Apply physical state multiplier:
Subscore B x Physical State Multiplier = Waste Characteristics Subscore ___40 x _1.0 = ___40

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III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists, proceed to C. If no evidence or indirect exists, proceed to B.

Subscore ____

B. Rate the migration potential for three potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface water migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	3	6	18	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
SUBTOTALS			58	108
Subscore (100 x factor score subtotal/ maximum score subtotal)				53.7
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Groundwater migration				
Depth to groundwater	1	8	8	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTALS			50	114
Subscore (100 x factor score sub-total/maximum score subtotal)				43.9

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above. Pathways Subscore 53.7

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors 77.7

Waste Characteristics 40

Pathways 53.7

TOTAL 171.4 divided by 3 = 57.1 Gross total score

B. Apply factor for waste containment from waste management practices. Gross total score x waste management practices factor = final score.

57.1 x 1.0 = 57.1

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: DRY CLEANING FACILITY (CS-7)

Location: MASS. MILITARY RESERVATION

Date of Operation or Occurrence: 1960's - 1975

Owner/Operator: Air Force 1950's-1975 Coast Guard 1975-1986

Comments/Description: Coin Operated Dry Cleaning Machines Which Use PCE

Site Rated By: M. Keirn

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1-mile radius	3	3	9	9
D. Distance to reservation boundary	1	6	6	18
E. Critical environments within 1-mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by groundwater supply within 3 miles of site	3	6	18	18
SUBTOTALS			134	180
Receptors subscore (100 X factor score subtotal/maximum score subtotal)				74.4

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1 = small, 2 = medium, 3 = large) 1
2. Confidence level (1 = confirmed, 2 = suspected) 2
3. Hazard rating (1 = low, 2 = medium, 3 = high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 40

B. Apply persistence factor:

Factor Subscore A x Persistence Factor = Subscore B   40 x 1.0 = 40

C. Apply physical state multiplier:
Subscore B x Physical State Multiplier = Waste Characteristics Subscore   40 x 1.0 = 40

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists, proceed to C. If no evidence or indirect exists, proceed to B.

Subscore ____

B. Rate the migration potential for three potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface water migration				
Distance to nearest surface water	1	8	8	24
Net precipitation	3	6	18	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
SUBTOTALS			42	108
Subscore (100 x factor score subtotal/ maximum score subtotal)				38
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Groundwater migration				
Depth to groundwater	2	8	16	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTALS			58	114
Subscore (100 x factor score sub-total/maximum score subtotal)				51

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above. Pathways Subscore 51

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	74.4
Waste Characteristics	40
Pathways	51
TOTAL	165.4 divided by 3 = 55.1 Gross total score

B. Apply factor for waste containment from waste management practices. Gross total score X waste management practices factor = final score.

55.1 x 1.0 = 55.1

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: __FORMER_ASPHALT_HOT_MIX_PLANT_(FS-2)__

Location: ___BEHIND_BASE_SERVICE_STATION__

Date of Operation or Occurrence: __1941-1943__

Owner/Operator: _Lane_Construction/Army_Truckyards__

Comments/Description: Used diesel fuel or kerosene to wash asphalt out of buckets.

Site Rated By: ____

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1-mile radius	3	3	9	9
D. Distance to reservation boundary	1	6	6	18
E. Critical environments within 1-mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by groundwater supply within 3 miles of site	3	6	18	18
SUBTOTALS			130	180
Receptors subscore (100 X factor score subtotal/maximum score subtotal)				72

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1 = small, 2 = medium, 3 = large) __3
2. Confidence level (1 = confirmed, 2 = suspected) __2
3. Hazard rating (1 = low, 2 = medium, 3 = high) __3

Factor Subscore A (from 20 to 100 based on factor score matrix) __70

B. Apply persistence factor:

Factor Subscore A x Persistence Factor = Subscore B __70 x _0.8 = __56

C. Apply physical state multiplier:
Subscore B x Physical State Multiplier = Waste Characteristics Subscore __56 x _1.0 = __56

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists, proceed to C. If no evidence or indirect exists, proceed to B.

Subscore ____

B. Rate the migration potential for three potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. Surface water migration				
Distance to nearest surface water	1	8	8	24
Net precipitation	3	6	18	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
SUBTOTALS			50	108
Subscore (100 x factor score subtotal/maximum score subtotal)				46
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Groundwater migration				
Depth to groundwater	2	8	16	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTALS			58	114
Subscore (100 x factor score subtotal/maximum score subtotal)				51

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above. Pathways Subscore 51

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	72.2
Waste Characteristics	56
Pathways	51
TOTAL	179.2 divided by 3 = 59.7 Gross total score

B. Apply factor for waste containment from waste management practices. Gross total score X waste management practices factor = final score.

59.7 x 1.0 = 59.7

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APPENDIX I

INDEX OF REFERENCES
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